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SECTION OF AGRICULTURE AND ALIMENTATION, PARIS EXPOSITION.

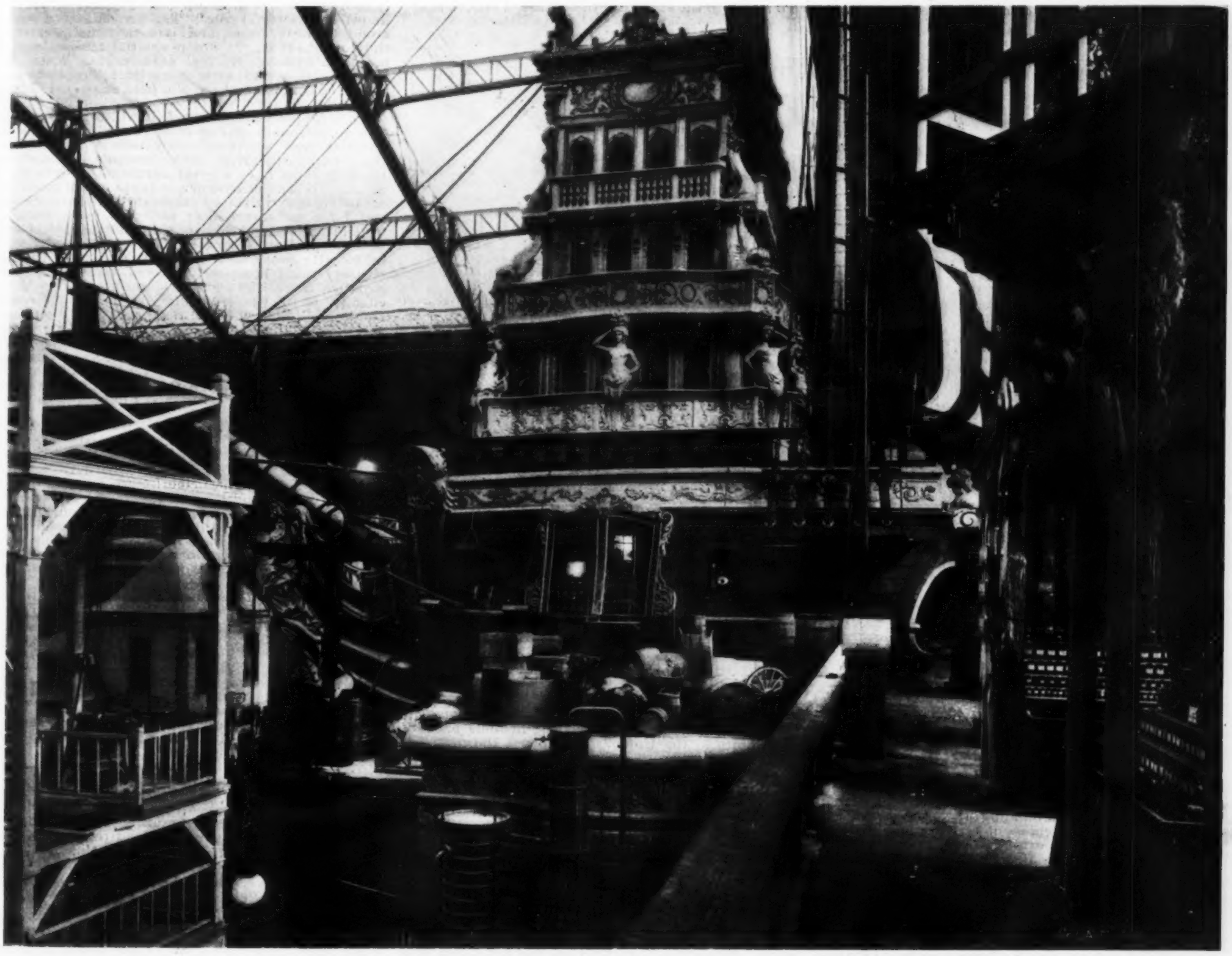
THE section devoted to agriculture and aliments is by far the largest of the Exposition, as it occupies nearly the whole of the immense Machinery building, left from the Exposition of 1889, which extends across one end of the Champ de Mars. The circular Salle des Fêtes, which has been built in the middle, now divides it into two parts; the French section occupies one half and the foreign exhibits the other. The "clou" of the French section is the exhibit of Menier & Company, the famous chocolate manufacturers; the illustration shows its general appearance. The upper part is a reconstruction of the vessel "Triumphant," which was the first to establish commerce between France and the Antilles. The commemorative tablet states that it came back to Brest in 1691, and brought to the king Louis XIV. a number of the native products, among which was chocolate prepared from the first plantations of Martinique. Below the vessel is a series of four rooms representing the different stages of chocolate manufacture, and the actual machines are seen working; the background is painted to represent the interior of the factories, making the illusion complete. Here is seen the torrefaction and grinding of the cacao, the preparation of the chocolate, the moulding presses and packing. The retrospective section is also of great interest; it has been installed by the Minister of Agriculture, and consists of a number of buildings reconstructed in the ancient style. These include farm buildings, blacksmith's shop, tavern, etc. A view of one of the farm buildings will be seen in the engraving. On the left is a wine press of 1720; it was made to descend by a wooden screw, which was turned either by a lever or by a wooden wheel carrying a rope which passed to a windlass on the ground. To the right may be seen one of the first presses in which wooden gearing was used; it dates from 1420. A large vertical wheel is turned by hand, and the movement is transmitted to the screw by a series of rude wooden gears. Around the building are a number of life size figures, representing shepherds, field guards, etc. Among the numerous specimens to be found in the interior may be mentioned a series of reduced models of presses and a collection of Gallo-Roman pottery found at Paris. The specimens of the Neolithic period show the lake-dwellers' utensils, among which are stone hatchets and primitive grinding mills. Of the Gallo-Roman period the most noteworthy objects are a stone grinding mill and a collection of iron implements, among which is a *vomer*, or Roman plowshare. Various forms of horseshoes of the Middle Ages coming from all parts of Europe are to be seen. Next to this building is an ancient blacksmith's shop in which is a group of two men shoeing a horse, with the forge and the different tools; here are a great number of wooden plows one or two centuries old, and a primitive thrasher dating from 1785.

The greater part of the section is devoted to a number of ornamental structures, most of them executed in the ancient style, which contain the exhibits of the various wines of France. The Pavilion of Gironde contains a number of panel paintings on the exterior, and inside are panoramas of the region. The Palace of Champagne is a highly ornamental structure, and in the interior are represented the various processes. In one corner of the building has been erected a reproduction of an old water mill, driven by an overshot wheel. It is mounted upon a rocky sub-structure, and its pointed roof reaches nearly to the height of the building.

The foreign section contains a great number of handsome structures erected by the leading nations, and each of these has a very complete exhibit. The façade of the Russian section is formed of columns covered with wheat grains, and a number of stuffed sheep are arranged around the outside. In the rear of the exhibit are two dioramas of the Caucasus Mountains, surrounded by rocks. The section contains cereals and products from all parts of the country, and covers a large space. The Minister of Agriculture and the government stations are well represented by a series of charts and illustrations. The collection of meteorological instruments designed by Prof. Broounoff is very complete. A large space is devoted to the individual exhibits of Russian firms, and a number of ornamental structures have been erected.

The structure erected by the German government is a long pavilion in two stories, the ground floor being divided into sections containing displays of agricultural implements and machines, milling machines and others. H. Lanz, of Mannheim, has a large thrasher and engine, and many other important firms are represented. In one end is the collective exhibit of the Imperial Sanitary Institute of Berlin, including the instruments used for examining alimentary products. A number of firms expose alimentary products of all kinds, and the hop culture is well represented. The upper floor contains the exhibits of the government agricultural schools and experimental stations.

A large space has been allotted to Great Britain, and is especially devoted to agricultural machines; all the

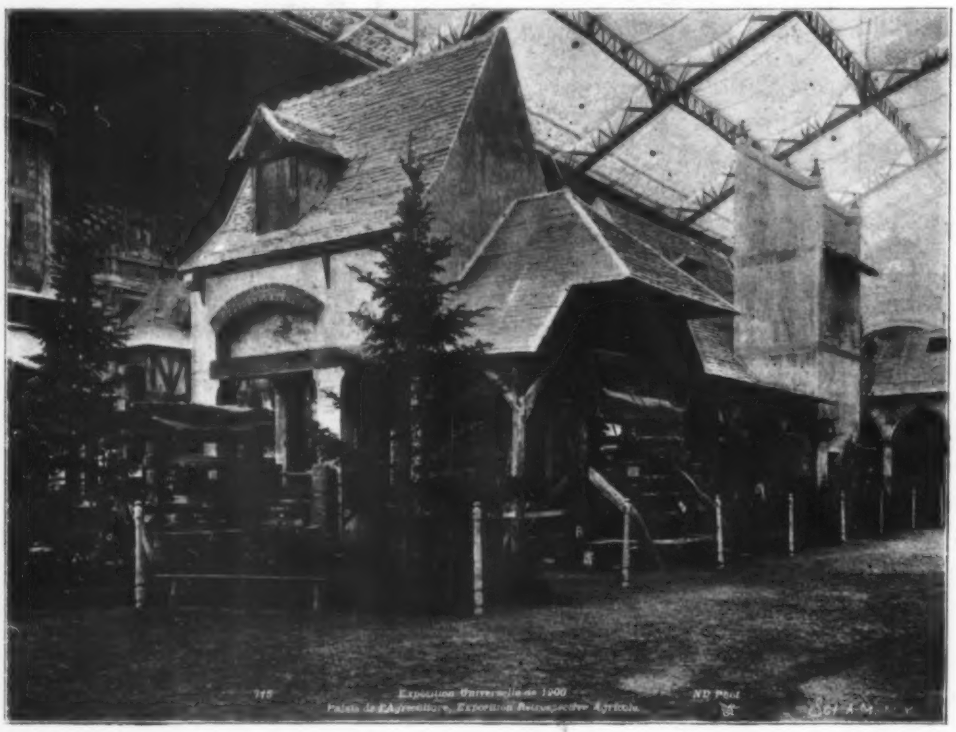


INTERIOR OF THE PALACE OF ALIMENTATION AT THE PARIS EXPOSITION.

leading firms are represented, and show the most improved types of harvesters, thrashers and milling machinery. Arthur Guinness, of Dublin, has a large model of the St. James Gate Brewery, to a scale of $\frac{1}{16}$ inch to the foot, with various models of wagon, train and canal boat transportation. An interesting exhibit is that of Huntley & Palmer; a large model of the works is shown, besides a wedding cake more than six feet high and weighing 230 pounds. The Royal Agricultural Society of London has an exhibit showing different varieties of grains. The Bovril Company show specimens of the condensed foods which were prepared for Nansen and used by him during his three years' voyage, being part of the stores carried on the "Fram." The Colman mustard works is represented by a model 8 by 20 feet, showing the different factory buildings.

Austria has a large space surrounded by an ornamental structure of white staff, with relief designs. The exhibit of Hungary, which adjoins it, is also quite extensive. The large ornamental façade is formed of painted reliefs of a pleasing character interspersed with grain stalks. In front is a large collection representing the silk industry, including several pyramids of cocoons in glass cases. A number of models show the structure of the silk worm on a highly magnified scale, and complete specimens. The models of horses and cattle in this section are very well executed. The section of apiculture is represented by improved forms of hives and various specimens. The Royal Veterinary School of Budapest shows the skeleton of the famous race-horse Kingsem, victor in fifty-four races. An interesting exhibit is that of the Royal Academy of Agronomy, which besides many specimens of grains, shows a model illustrating the method of destroying grasshoppers, these being driven between two converging walls into a pit by a line of men, and a fire is built in the pit afterward.

The Swiss section has an ornamental pavilion of carved and painted wood, of a handsome design. In the interior is a plan in relief of the Engadine, and another of Montreux executed to 1–5,000 by Prof. E. Becker, of Zurich. The section contains a number of decorative panels with views of Switzerland. The leading firms have exhibits of chocolate, condensed milk and other products. A large section is devoted to the cheese and milk industry. In the back of the exhibits in a model mill building of two stories, erected to show the milling machines of G. Daverio, of Zurich, and near it are other exhibits of milling machines. The Holland section has an interesting model showing a rice plantation in Java, measuring eight by twenty feet; the preparation of the ground, sowing the crop, the harvest and thrashing of the grain are all shown, and the models of the natives in miniature are well executed. Spain is represented by a high pavilion executed in the Moorish style and highly ornamented with painted and gilded designs; a large arch spans the entrance. The exhibits are principally made up of wines and oil from different parts of the country; some of these are shown in graceful structures; one pavilion is constructed of bottles of olives. Adjoining it is the section of Portugal, whose main façade represents a farm building in the ancient style, with a high tower. It is ornamented with a number of ox-yokes carved in curious designs. The space is covered by a high trellis with grape-vines. The greater part of the exhibits consist of port and other wines. Adjoining is the official section, including collections of grains, oils and wines. An interesting collection from Liberia is shown here, including coffee, manioc and caoutchouc in various forms.



RETROSPECTIVE SECTION, PALACE OF AGRICULTURE AT THE PARIS EXPOSITION.

THE EUCALYPTUS.

By Nicolas Pike.

As we have all climates in our great country, and means and ability to utilize them, it behooves us to introduce from every quarter of the globe products that may eventually benefit us; especially anything that can assist us in the great problem of purifying our atmosphere, in view of the vast hordes flocking to our shores. We have extensive tracts, now in their primitive barren wastes or swamps, that will very soon have to be reclaimed for occupation. Therefore, I wish to speak of trees, of course generally known by name, but not familiar to the public at large for their valuable properties. They could be imported and planted by thousands, to advantage in the near future, not only as a sanitary measure, but for industrial and commercial profit also.

To digress for a moment from my subject, I would call attention to the progress made in the last half century by scientific research in every branch of every profession. Especially is a change noticeable in medicine and surgery. In the latter, so marvelous have been the discoveries, and such delicate operations are daily performed with almost miraculous skill, that it really seems as if very soon there would be few ills the body is liable to that the surgeon's knife cannot reach.

In medicine, too, how the developments of Hahnemann's theories have proved we can get well without being dosed, and bled, and blistered in a way that no respectable owner would treat a horse or dog nowadays. In physic, however, there is much to be learned, and peculiarly is this true in regard to malarial troubles. There are plenty of theories and so-called remedies, but, as in many other diseases, effects are only too often ministered to, and the cause ignored, yet few ills in the aggregate give more suffering than malaria.

In most diseases fever acts a prominent part, and if careful statistics could be made of the actual exciting cause, no matter what form the effects take, in more than half malaria would be found; perhaps inhaled from sewers, foul odors and gases, marshes, etc., but still in the blood. Surely then any remedy that could purify our surroundings should be heartily welcomed.

To return to the subject of this article, I believe that in the trees of the eucalyptus family a relief may be found for the malaria so prevalent in some parts of every State in the Union. Australia is the principal home of the eucalyptus, where it forms 90 per cent. of the forest trees. All have gummy secretions, and from the varied tints of the foilage go by the local names of blue, red or white gum trees. From the peculiar bark of many they are also called "stringy bark trees." To us moderns, our knowledge of them only extends to the discovery of New Holland, the former name of the great fifth continent, but geologists give them a very respectable antiquity, as they are said to have had representatives in early Eocene times.

Nearly all the eucalypti grow very tall, some of them rivaling our giant Sequoia Wellingtonia in height. An English naturalist measured one 400 feet high, and four men on horseback could stand in a cavity of the trunk. One of the E. amygdalina that had fallen in a mountain gorge was 420 feet long, with circumference in proportion, and some in the Yarra district are over 500 feet.

There are more than one hundred specimens of eucalyptus, but I will only mention a few of the most important and useful. Very many have long attracted notice from their valuable properties, and they ought to be better known here. Their flowers are apetalous, but have masses of stamens like the myrtle. The bud has an operculate calyx, formed by several jointed leaves, united throughout, and separating at the articulation in the shape of a lid which flies off when the flower expands.

The E. oleosa or piperita has the smell and qualities of the famous cajeputi (Melaleuca minor), so well known in India for the cure of rheumatic affections. The wood is extensively used for fuel and the bark for paper making. It does not grow to the great height of some species, but covers large tracts of ground, the roots running horizontally over the surface.

From the E. mannifera exudes in the dry season a saccharine, mucous substance resembling manna in action and appearance, but less nauseous. E. gunnii furnishes a copious supply of cool, refreshing, slightly aperient liquid, which ferments and acquires the properties of beer. The giant eucalyptus is sought for its beautifully veined wood, and is called the mahogany of Australia. The E. resinifera has pendent branches resembling a willow. The bark is very thick, and is taken off in sheets as a covering for the houses of the natives, and it yields also a kind of gum kino sold in the medicine bazars of India for its use in diarrhea.

From the last two mentioned an abundant juice flows of a red color, containing considerable gum and tannin, and a single tree will often yield 60 gallons.

All the above are valuable, but none to such an extent as the E. globulus.

It has strong roots and smooth bark, and the bluish leaves give it the name of blue gum tree. Every part of it exhales a powerful, balsamic odor, and the leaves and seeds when crushed smell like tobacco. Bees are strongly attracted to this tree, and nests yielding abundant honey are often found in it. The wood is very hard and heavy and greatly used for building and naval purposes. It is of a fine red color, and very durable, as neither air nor water acts on it, and insects do not attack it. It is especially sought for in the construction of railways.

Many species of eucalyptus have the properties of cinchona in their leaves and bark, but none equal to the globulus, which has them more abundantly than the Brazilian tree. Van Vauquelin obtained by analysis an essential oil containing eucalyptal camphor closely resembling the resin of cinchona. This extract yielded a substance capable of neutralizing the strongest acids, and forming crystalline salts. The sulphate crystallizes in star-shaped crystals like sulphate of quinine or cinchona. The narrow leaves of the tree are principally used, dried and powdered, and strong tinctures are made from them. The bark also produces favorable results. So efficacious are preparations from this tree in marsh and other fevers that it is known as the "fever tree." The medicine has a warm, aromatic, bitter taste, and is invaluable in exciting the flow of saliva. It lowers arterial tension, and is useful in hysteria, cerebral anemia, etc. When the leaves are smoked, they relieve asthma, bronchitis and whooping cough, and have also been employed instead of lint for wounds.

When properly administered, it will certainly eradicate all poisonous matter from the system, and cure malarial fevers, where quinine utterly fails to do more than temporarily arrest them. The preparations from the eucalyptus have a great advantage over those of quinine. When excessive or constant doses of the latter are taken, they will often establish some local disease, and I am not surprised at seeing so many sufferers from malaria when I think of the quantities swallowed. In some malarial districts I have seen quinine pills taken with every meal for weeks together. The alimentary canal becomes disordered, nausea and constipation ensue, and a febrile state is set up, with excitement of the whole vascular system. The cerebral and spinal organs become deranged, throbbing headaches and giddiness often occur, sight and hearing are weakened, and the spleen sensibly affected. The joints, especially the wrists and ankles, suffer, and when diarrhea or dysentery follows, it is very difficult to cure. In fact, unless administered by a skillful physician, quinine is a dangerous drug, and I have known many fatal cases from its misuse.

Now, the eucalyptus has almost the reverse effect of all this; has none of the ringing of the ears and troubles caused by quinine, and prevents all stomach complications. A well-known Brooklyn doctor assured me it was the finest medicine known for that terrible Bright's disease, and I feel sure, if fresh powder could be procured, it would be of incalculable benefit to the victims of malaria. I think I have said enough of its varied uses, and will now show the good it has done elsewhere, and there is no reason why we could not have all the benefits to be derived from it in our own country.

Up to 1870 one of the most fever-stricken countries of the world was the Maremma, the Roman Campagna, where the neglect of ages had allowed stagnant marshes to form in what was once a well populated, healthy district, till it could only be inhabited a small part of the year. At that time large plantations of the eucalyptus were made, and the Trappists have a large establishment there where they live all the year round, fever being almost eradicated. They use the wood for their buildings, and say it is the best and strongest they can procure. In Nice, Mentone, Corsica, the South of France, Egypt, Sierra Leone, Natal, Tahiti, etc., where they have been extensively planted, fevers are fast disappearing. Over a million trees have been planted in Algeria, and their sanitary influence has been most marked. Wherever they have been planted in compact masses, there intermittent fevers are greatly diminished and much marshy land reclaimed. They have been very largely cultivated in some districts in India, and the inspector of forests writes that, irrespective of their salubrity, the wood is very valuable, and at ten years old a tree is worth £20. In California the eucalyptus has been planted with the object of lessening droughts along the line of the Central Pacific Railway.

All these places were more or less deadly from the miasma engendered by festering marshes and other causes. Now life is not only bearable, but enjoyable, from a very simple source—the taking advantage of one of nature's own cures. By planting these trees in numbers their roots have drained the soil, and by some elaborate process have absorbed the contagious effluvia, and the leaves give out the balsamic odors so healthful to breathe.

The peculiar region of these trees is the temperate part of Australia and Van Dieman's Land. They thrive in a mean temperature of 59° to 72°, but I think they will grow in 45° to 50°. Of course this prevents them becoming hardy denizens of our Northern States. They will, however, suit admirably our Southern ones, especially in sandy soils near the sea. They grow easily from seed, and are of very rapid growth, and if the various kinds are planted out unsparingly, they might become large factors in the new industries that would spring from their cultivation, and our vast waste marsh lands would be utilized as well as rendered salubrious for occupation.

Though our northern climate forbids this culture out of doors, there are plenty of ways and means by which

the eucalyptus can be made available even here. First of all, I would say a word to the florists so widely spread over our country now. The peculiar conditions of temperature, etc., of their hot and green houses render all who work in them very liable to malaria. To them it would be an easy matter to grow a plant in every house, which could be checked back to keep it within bounds, and the sanitary state of their premises would soon change. It would be well to sow the seeds of the E. globulus largely for distribution. Every railway depot, hotel, or any other building where many people congregate could use this plant advantageously. Especially is it advisable, as persons are constantly coming and going who are filled with malarial and other germs from various infected localities. The powerful germ-destroying odor of the plant would kill any floating in the atmosphere and help the sufferers too.

There are few schools that cannot spare a window on each floor for a plant in the winter months, to be put out in a tub in summer in the playground. Every hospital has wide, windowed corridors, and it would pay to have a well kept eucalyptus in each one. Even mansions that can boast of spacious staircases and halls might spare a niche for a blue gum, as it can be constantly checked in its too liberal growth. It can be put out as a handsome ornament to the grounds in summer, and new ones reared for the house every year.

The seeds are very easily raised, but it would be better to procure plants about a foot high from the florist. The rapid growth of this tree is something abnormal in vegetable life. I planted some once, and although I headed them well back when three or four feet high, in one year they were above the roof of a one-story house. Of course not here in the North. I have grown all three of the gums, blue, red, and white, and when young they are very pretty, especially the red gum. The plants must be constantly nipped back to make them strong and stocky, and be grown in good soil with considerable sand in it, and kept well watered. The whole plant gives out the peculiar odor, but it is not unpleasant.

THE ZENITHO-NADIRAL TELESCOPE.

To the physicist and the astronomer, the exact determination of directions is one of the most important of practical problems. In astronomy in particular, the method that has long been practised of registering directions with respect to the vertical of the place of observation gives great importance to the precise knowledge of the point at which this vertical is to be met with above our head—the celestial sphere, the "zenith."

Up to the present, the determination of the zenith has been subordinated to that of the "nadir," which is the point at which the vertical, after traversing the celestial globe, meets the celestial sphere above us. Among the various processes employed by astronomers for the determination of the nadir, we shall recall but one, that which is directly founded upon that well known proposition that the vertical is at right angles with the surface of a liquid in equilibrium. A telescope is quite easily arranged in the direction of the nadir by providing it with a reflection ocular and reticule and observing the surface of a perfectly quiet mass of mercury with it. We are sure that the optical axis of the telescope is pointed exactly toward the nadir when the image of the threads of the reticule, seen through reflection in the mercury, is superposed upon the reticule itself in the field of the instrument. When such is the case, the telescope is revolved by 180 degrees upon the vertical graduated circle that carries it, and we have thus the direction of the zenith. But this latter operation is submitted to several causes of error, due to the torsion of the axes of rotation and to defects in the graduation of the divided circle.

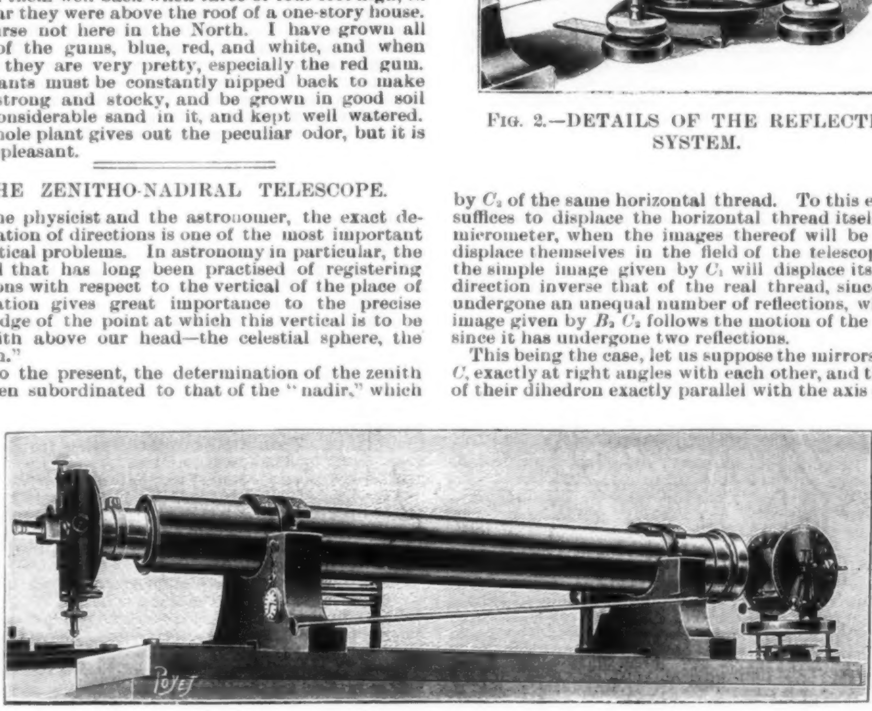


FIG. 1.—CORNU'S ZENITHO-NADIRAL TELESCOPE.

All the other processes utilized for the indirect determination of the zenith are submitted to causes of error analogous to the preceding. The problem of the direct determination of the zenith is now solved, and we owe to the learned French physicist, M. Cornu, an apparatus that permits of directly connecting the observations of the zenith with those of the nadir without any movable auxiliary arrangement. M. Cornu's apparatus is composed essentially of a horizontal telescope oriented in the meridian and provided with a micrometer with a movable thread and a reflection ocular. This telescope points toward the center of a reflecting system arranged as shown in the accompanying Fig. 2. This system consists of a mercury bath, *A* (Fig. 3), and two plane mirrors, *B* and *C*, one fitting into the other, through a slit. These two mirrors are inclined at an angle of 45 degrees with the vertical and are capable of revolving conjointly around an axis parallel with the edge of their dihedron, which is placed at right angles with the meridian.

The mirror, *B*, is turned upwardly, while *C* is turned in the contrary direction and faces the bath of mercury. The right and independent part, B_1, of the mirror, *B*, sends into the telescope the image of the zenithal region of the heavens, and the left and independent part, C_1, of the mirror, *C*, sends the luminous pencil from the telescope upon the bath of mercury. This pencil, upon reaching the mercury, is reflected therefrom, re-enters the telescope, and forms therein the focal image, reflected from the micrometer. This latter consists of two threads, one horizontal and movable and the other vertical and fixed. The mirrors, *B* and *C*, act through their portions, B_2 and C_2, and the two threads of the micrometer are reflected from this dihedron; but, while the vertical thread, at right angles with the edge of the dihedron, gives a simple image, the horizontal thread gives such an image only on condition that the two mirrors be exactly at right angles with each other. If such a condition be not realized, we shall have two symmetrical images situated on one side and another of the simple image given

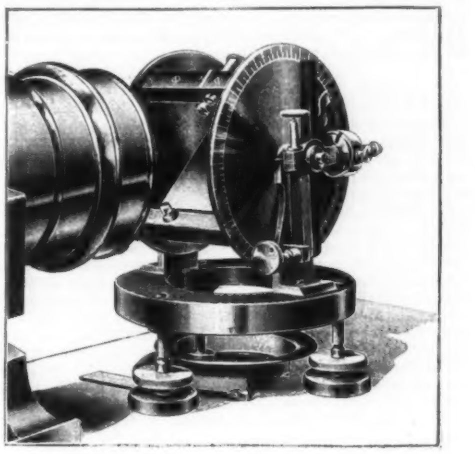


FIG. 2.—DETAILS OF THE REFLECTING SYSTEM.

by C_1 of the same horizontal thread. To this effect, it suffices to displace the horizontal thread itself in the micrometer, when the images thereof will be seen to displace themselves in the field of the telescope; but the simple image given by C_1 will displace itself in a direction inverse that of the real thread, since it has undergone an unequal number of reflections, while the image given by B_2 C_2 follows the motion of the thread, since it has undergone two reflections.

This being the case, let us suppose the mirrors, *B* and *C*, exactly at right angles with each other, and the edge of their dihedron exactly parallel with the axis of rotation of the system of the two mirrors and at right angles with the optical axis of the telescope. Let us incline the system in such a way that the crossing of the threads of the reticule shall coincide with its image given by the bath of mercury. As the mirrors are rectangular, the twofold image of the horizontal thread given by the dihedron will coincide with the horizontal thread itself. Under such conditions, nothing will remain in the field of the telescope except the image of the zenithal region of the heavens furnished by B_1 and the crossing of the threads that determines the direction of the nadir, and, according to a well known property of rectangular mirrors, defines the zenith at the same time. In a word, the zenith coincides in the telescope with the nadir; whence the name zenitho-nadiral telescope proposed by M. Cornu

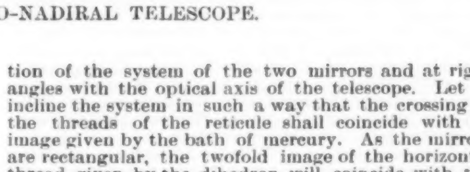


FIG. 3.—DIAGRAM OF THE ARRANGEMENT OF THE APPARATUS.

for the elegant arrangement that we have just described.

In what precedes, we have supposed that the mirrors were exactly at right angles with each other. In reality, in practice, this is a condition that will be rarely found realized; but, far from being an obstacle to the method, this fact permits of more accurate results, as M. Cornu has shown. We shall not follow the learned physicist in this latter part of his remarkable work, which is a little more delicate than the first. It will suffice to have explained the principle of the instrument, which naturally requires a whole series of very delicate regulations. One of these apparatus has already operated in one of the cupolas of the Paris Observatory and given the best of results.

For the above particulars and the illustrations we are indebted to La Nature.

TIN IN ANCIENT AND MODERN TIMES.

AMONG metals, tin is, no doubt, one of the earliest that has been in use, as we learn from a highly interesting, if somewhat discursive, article which appears in the Revue Scientifique, from the pen of M. Brau de St. Pol Lias, of which we give an abstract. It is one of the most precious and interesting of metals. It ranks next to gold and silver for intrinsic value among ordinary metals. It has the color and nearly the brilliancy of silver when pure, but it is less resisting and more malleable. Tin heated by rubbing has a very pungent odor and taste. When bent, the disaggregation of the crystals forming its mass, without any breakage being produced, makes a peculiar noise which metallurgists call the crackling of tin, and which enables a practiced ear to form a fairly accurate idea of its degree of purity. Tin is not found in many places, being thinly sprinkled over the surface of the globe. It is not found everywhere, like gold, for example, and it lies hidden under the form of a blackish mineral, which, to a profane eye, has not the least appearance of being the receptacle of a metal.

The Malay Peninsula, the Golden Chersoneses of the ancients, may be considered its natal land, and it still remains the true country of tin. It is contiguous to the equator, at the southeast extremity of Asia, separated from Sumatra by the Straits of Malacca. It is reached from Europe by the well-known route across the Mediterranean, Suez Canal, Red Sea, and the Indian Ocean—about one month by steamer—disembarking either at Penang or Singapore. Penang at the entrance, and Singapore at the head of the Straits of Malacca, are two islands and two English towns. The Peninsula of Malacca at the present day, moreover, is English from one end to the other, or tends to become so. Perak, in Malay, signifies silver. It is the name of the tin district par excellence. The manner in which a tin mine is attacked and worked at Perak is of the greatest simplicity. After having cleared the land of the brushwood, the vegetable soil and the unproductive layers, ranging from three to ten feet in depth, are taken away, in order to lay bare the ore, the stanniferous stratum, which has sometimes a thickness of ten feet. The washing of stanniferous soils is done by coolies provided with rakes, who take away the pebbles and mix the materials so as to eliminate the light sands, mingled with oxide of tin, until at last there does not remain more than from 25 to 35 per cent. of foreign substances. The ore thus selected is smelted in small brick furnaces from five feet to six feet six inches high, blast being supplied by a bamboo bellows, a coolie moving a horizontal piston backward and forward. A bright white metal is obtained, cast in molds which give it the well-known form of the cubic ingots called block tin, with an elongated face and projecting on both sides so as to form ears, which enable the ingots to be more easily handled. The ore is very rich, the metal pure, but the way in which the Chinese work it is ridiculous and the quantity of metal wasted great. A fresh washing of what is thrown away would still be very remunerative. The Chinese and Malays call that "tima monda," young tin, and they restore it to the earth, doubtless in order that it may ripen, the metal being considered by them not old enough to remain in their primitive machines. It is only now that a beginning has been made to work these Perak mines in a rational way, yet for many centuries tin has been known and worked in the Malay Peninsula.

The use of tin goes back to the highest antiquity. Homer mentions tin, "kassiteros," in describing the arms of his heroes. Herodotus, the father of historians, calls the British Isles "Kassiterides." The Phoenicians in effect found it in these isles, a little also in Gaul and the Iberian Peninsula, the tin which they spread through the ancient European world. But before the Phoenicians and the Greeks, the Chaldeans were acquainted with tin under the name of "kastira." Tin 5,000 years ago was designated by the word "anaku." The text of the Bible where Moses mentions tin is in the Book of Numbers. In ancient Egypt bronze statuettes of a tin alloy have been found which date from the epoch of the Pyramids, 3600 B. C.

In a recent work (La Nêerlande Industrielle, Brussels, 1887), M. De Ramaix gives these statistics:

	Tons.
Dutch Indies, islands of Bangka and Billiton, etc.	10,000
Cornwall	8,000
Australia	7,000
Total	25,000

The Malay states of the isthmus of Malacca exported to Penang in 1877, in round numbers, 2,500 tons of tin, and the Siamese states of the same country 7,000 tons, being over 9,000 tons. Personal information permits us to establish that the exports from Perak in 1881 amounted to 6,139 tons. At the present day the total production of the world may be estimated annually at nearly 45,000 tons.

There is scarcely a household, however humble, in which some article in the manufacture of which tin enters is not met with. The amalgam of tin applied to glass is so common that there is hardly any uncivilized country into which mirrors have not found their way with European glassware. Soldering, which is employed in innumerable ways, requires tin chiefly. Tin foil makes good wrappers for food. Type metal, used by type founders, has tin in its composition.

In the middle ages tin passed from the Gauls to the Merovingians. Even the roofs of basilicas were formed of it, according to Gregory of Tours, and coverings for tombs. It was much used in convents, where it was wrought for a long time, and in churches, where it was made into religious objects of all kinds—crosses, candlesticks, holy water fonts, basins, jugs, cruets, organ pipes, ampullæ, pilgrims' badges, etc. It has been used in the tenth century with gold and silver for the making of sacred vessels, when wood, lead, copper, and bronze were interdicted as common or insalubrious, and glass on account of its fragility. Bishops and

priests were buried with their emblems, crosiers, and chalices represented in tin.

It is chiefly in the fourteenth and fifteenth centuries that the use of tin became popular in Europe. Tinplate became common in everyday use, even with the peasant and the workman, extending even to the animals.

The most wonderful works of art which have remained from that age were produced in France and Germany, chiefly at Nuremberg. Tin has had all the honors of the precious metals. It shares with them yet another advantage, that of perfect salubrity. On that account, medicaments which might be spoiled by contact with other metals were preserved in tin boxes.

Tin is a wholesome metal par excellence, and it owes to this quality, besides the numerous uses already mentioned, an application of a most important kind—tinning, which was invented, as Pliny attests, by the Gauls. If the Auvergnois were the first tinkers, it is consoling to meet at length, what is so rare, inventors who have not allowed themselves to be robbed of the benefit of their invention, and have enjoyed it for a long time.

Again, to-day, after twenty centuries, traveling workmen who traverse all the villages of France, and perhaps those beyond her frontiers, making the well known cry heard, "Spoons, forks, saucepans to tin," and working in the open air, to the infinite glee of children, are the tinkers of Auvergne. It is by tinning that tin plate is obtained, which is merely sheet iron tinned.

We shall have passed in review all the chief uses to which tin is devoted when we recall to mind the casting of bells, statues, and all the bronze or brass objects in the alloy of which we find tin at every age, and even with the ancient Egyptians, the date of which has already been fixed at the thirty-sixth century before our era. But from where could the tin come at so remote an epoch?

Which was the country, producing tin, sufficiently advanced in civilization more than fifty centuries ago for its inhabitants to have had sufficient knowledge to enable them to recognize the metal in this oxide, with blackish grains of sand, which is its ore, and a social organization such as to enable them to undertake and successfully conduct the long operations of extraction, washing and metallurgic treatment demanded in the exploitation?

In one of the most remarkable and most interesting works written on this subject ("L'Étain," by Germain Bapst; Paris, E. Masson, 1884), the author is inclined to think that it was the Malay Peninsula. A curious comparison has been made between the names which the Malays of the Peninsula give to tin and lead, "tima pouté," white tima (tin) "tima itam," black tima (lead), and the names given to them by Pliny, "plumbum candidum," white lead (tin), "plumbum nigrum," black lead (lead), and also between this Malay name "tima" and the English, Dutch, Danish "tin," German "Zinn," Swedish "tenn."

Etymologists, doubtless, ask themselves whether this Malay appellation of tin—at a time when the Kassiterides, yet nameless, lay in the solitude of their dense forests, like Gaul and Iberia, in the pre-historic epoch of our countries, when the primitive populations of Switzerland, who also used tin for ornamenting their earthen vases, had not yet built their lake dwellings—did not leave Malacca, and arrive much later no doubt, borne through slow migrations, but directly, and over the heads of the Assyrians and Greeks, as far as the extremities of Europe. Thus it would be the Malay Peninsula, covered at the present day with virgin forests, which at that time was at the head of the civilized world, possessing everything which constitutes the last expression of progress, without doubt, under very different forms.

DISCOVERY OF THE OLDEST KNOWN LETTERS IN THE WORLD.

IN the course of several recent expeditions to the East, Dr. Ernest A. Wallis Budge, keeper of Egyptian and Assyrian antiquities in the British Museum, was the discoverer of a most valuable collection of small tablets of the envelope or duplicate class, found in the ruins at Telisefr in South Babylonia, representing the ancient city of Larsa (the "Ellasar" of Genesis, chapter xiv). These tablets consist partly of contracts and other legal documents, partly of public and private letters. The latter have just been carefully arranged, and for the first time their full importance is evident. *Biblia* (August) pronounces them "the most important series of inscriptions which has ever been rescued from Oriental ruins." The writer says of this collection:

"It is a group of fifty letters, written by Khammurabi, King of Babylon, who reigned about 2300 B. C., and who is generally identified with the Amraphel of Genesis xiv. We have already been made acquainted with the existence of a system of letter-writing in use among the kings of the East at an early period, as illustrated by the famous Tel-el-Amarna tablets. These, we know, present the diplomatic and private correspondence between the kings of Syria, Mitani, or northern Mesopotamia, and Babylon, and may be dated about 1450 B. C. The valuable series of tablets which has recently been received for the British Museum belong to a period of 1000 years earlier, and are certainly the oldest known letters in the world. The position of those Babylonian letters in Oriental literature is of extreme importance. They reveal the existence of a regular system of correspondence between rulers and their subordinates, and that writing was used not only to record events in royal annals, but for ordinary purposes. They are, besides, manifestly the models for all after time, as in the case of the diplomatic correspondence in the Tel-el-Amarna tablets. We can now see how overshadowing was the influence of Babylonia over all Western Asia. During the thousand years which elapsed between the time of Khammurabi and the date of these later letters discovered some years ago, Babylonia became the educational center of the Oriental world.

"The great library at Borsippa was the school and university not only of Chaldea, but of Syria, North Mesopotamia and Asia Minor. Fragments of the deluge and creation tablets dated from a period more than 1,000 years before Moses have been discovered in Babylonia. It is therefore clear that if the scribes of Canaan were taught to write and use the cuneiform script through these influences, there must have been some among them who were acquainted with the traditions stored in the Chaldean libraries. The present find is indeed a good one; but one can only regard it as a prelude to still more important discoveries, which probably will put a new aspect on the vexed question of Hebrew origin. To possess letters contemporary with the time of Abraham is certainly an astonishing result of Oriental exploration, and one which far exceeds the wildest dreams of those who first revealed to us the buried cities of Assyria and Babylonia.

"Messrs. Luzac & Co., of London, have recently published the 'Letters and Inscriptions of Hammurabi, King of Babylon about 2300 B. C.,' to which are added a series of letters of other kings of the first dynasty of Babylon. The original Babylonian text is given with an English translation."

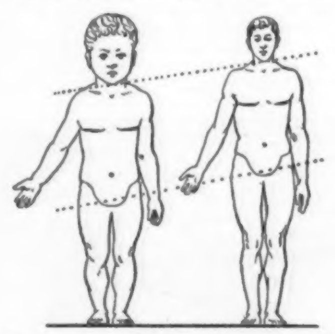
PHYSICAL GROWTH IN THE CHILD.

WHAT interests the educator in the development of the child may be arranged in four chapters. At the base of all is physical growth, the formation and development of the different elements of our organs. Immediately afterward comes the examination of the senses and sensations, and the measurement thereof in order to ascertain whether or not the development is normal. These first elements are necessary in order afterward to understand the development of our intellectual faculties, the periods and different stadia of their growth and the anomalies that it is of consequence to reveal and describe at the moment at which it is still possible to correct them. As in reality these first three parts tend toward one end, it remains, then, to consider their resultant and their synthesis into Will; how our motions and acts are organized, and how the character upon which depend the personal and social value and happiness of the individual is formed upon the basis of the temperament.

In this paper, we purpose to study physical growth only, from the results given by various researches made during the last twenty years. This rapid resumé, without pretending to give definite conclusions, will permit of appreciating the general trend of such researches, and of showing what results they are capable of giving in the hands of educators who are solicitous of their role.

I.

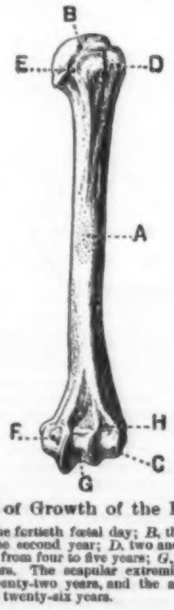
In order to fix the periods of growth of the skeleton, anatomists endeavor to ascertain what points of ossification appear in the different bones, and in what places and at what dates. The situation and number of such points being known, it is possible to deduce therefrom the age of a given skeleton, and, up to a certain point, even its dimensions at the end of growth. This work with the bones of the limbs begins and ends at the clavicle, which, at the thirtieth day of fœtal life, exhibits an osseous spot in the soft substance of the cartilage that marks its contours.



Relative Proportions of the Body of the New-Born Babe and the Adult.

It is not till the twenty-fifth year that all of its points of ossification finally join each other in an immutable mass. Between these two extreme dates there appear, each in its place and at its appointed date, the various centers of ossification whose radiation gradually builds up the mass of bone; and so with the entire skeleton.

The evolution of the humerus may be followed in the annexed figure. Its ossification begins at the thirtieth or fortieth day of fœtal life, and its entire growth is effected at eight points of ossification, each appearing at its own date, from the first to the fifteenth year. These points radiate through osseous prolongations and proceed to cling to their neighbors, and all this forms a compact tissue at the moment at which the whole solidifies, say at about the twentieth year. Thus constituted, the bone will thereafter neither grow nor increase in size.



Periods of Growth of the Humerus.

A, primitive point at the fortieth fœtal day; *B*, three or four months after birth; *C*, end of the second year; *D*, two and a half years; *E*, end of the third year; *F*, from four to five years; *G*, thirteen years; *H*, thirteen and a half years. The scapular extremity becomes soldered at from twenty to twenty-two years, and the antibrachial extremity at from twenty-one to twenty-six years.

All these datum points, thus collected, permit of following the formation of the osseous framework and of marking the stages thereof. But the process, it is hardly necessary to say, is applicable neither to the adult nor the child. It is an excellent means of afterward marking the place where the growth of the bone under study was; but in the living being it is well to employ another method and other datum points. As indices of growth, it has been generally customary to employ gross measurements of the weight and stature. What are the results of it? The human body is observed from its birth to its maturity to grow about three times and a half in height, and nearly twenty times in weight.

Such growth in height, as well as in weight, results from the proliferation of the cells—a multiplication proportional to the vitality of the individual.

At the beginning, each cell becomes segmented with extreme rapidity in order to produce others which undergo segmentation in their turn. The field is free to them. But, in measure as the organs become fit to perform their functions, the cells become at first sterile, and afterward senile, and finally remain as dead points limiting the extension of the organism. The vitality thus decreases, and the number of cells active enough to reproduce themselves diminishes, thereby increasing, by just so much, the number of the elements that are confined to keeping themselves in condition. A time therefore comes in which the entire organic work no longer serves for anything except to compensate for losses. This is adult age, when the organism, content to defend itself against the encroachment of dead waste, no longer grows. Old age begins when the accumulation of such waste outweighs the renewal of the cells.

It is easy to see that it is during these years of growth that the organism prepares its base of operations.

Growth in Stature.—At the beginning, the energy with which the cells multiply is such that the new-born babe nearly doubles its stature during the first year—it passing during that period from 18 or 20 to 28 or 32 inches. It is, moreover, at the beginning, during the first months, that this pushing forward of life is most active. The infant increases by $\frac{1}{15}$ in the first month and by $\frac{1}{16}$ in the second, and this decrease in progression continues to such a degree that the twelfth month adds no more than about $\frac{1}{75}$ to its stature. The following year the progress is about $3\frac{1}{2}$ or 4 inches for the twelve months, that is to say, the growth during the second year is, proportionately, about that of the first month. Then it falls to 2·75 inches for the third year, to 2·5 for the fourth, and to 2·4 only for the fifth and the years immediately succeeding.

As early as the sixth year, the child, whose muscular strength is already equal to half that of the adult, has thus doubled its birth-stature by extraordinary work, and accomplished two-thirds of its growth in a few years.

Some 20 inches will now suffice to complete the mean stature of man between 20 and 25 years.

These 20 inches, however, are unequally distributed over the years that have intervened since the appearance of the six-year tooth to adult age. For some years there is a mean growth of from 1 6 to 2 inches a year; but this ascension, which appears uniform when we consider the whole, is singularly irregular and uneven in detail. In following the curves that express its progress we see retardations and even arrests therein followed by abrupt impulsions as if to make up for the time lost or to utilize the energy accumulated. The earliest infancy had already exhibited a less regular and less rapid growth at certain periods, such as at the appearance of the first teeth; but such retardation was minimum. That which marks the second dentition, at between six and eight years, is much more sensible, and yet it is a slight disturbance as compared with the profound transformations that precede and follow puberty—that new birth. If, up to this time, the growth has appeared to be irregular, and even to be on a decline, its energy suddenly, and for several months, performs prodigies. Epoch decisive for the character and temperament, it is the age at which are established by preference the physical and moral chronicities that will later on fix the good or bad health of the individual and his social value.

FŒTAL GROWTH.

Increase in Stature.	Stature.	Age in Weeks.	Weight.	Increase in Weight.
		4	15 grains.	
		8	60 "	 3
7..........	3·2 inches.	12	300 "	 16
5..........	6 "	16	3·75 ounces	 100
19..........	8 "	20	8 1 "	 165
5..........	12 "	24	19·1 "	 350
5..........	14 "	28	38·2 "	 585
5..........	16 "	32	53 6 "	 480
5..........	18 "	36	70 "	 540
	20 "	40	101·8 "	 1010

Increase in Weight.—The increase in weight, while undergoing fluctuations analogous to those of the stature, does not, however, proceed exactly at the same pace. Very rapid during the first months after birth, it afterward gradually decreases in the same manner as the stature; but, while the latter, despite certain violent efforts, increases less and less up to its definitive arrest, we see the increase in weight rise again at certain dates until it reaches, and even exceeds, the figures of the first year. Let us not forget, however, how much greater, relatively, is a total increase of 19 pounds in a child in one year than is the increase in stature in an adolescent.

At the end of the first month the natal weight (about 6·5 pounds) has almost doubled, and at the end of the first year is has nearly tripled. This so rapid increase is nevertheless proportionately less than that of the

stature, the weight of the adult being equivalent to at least twenty times that of the new-born babe, while the stature is equivalent to only three and a half times. The increase keeps between 8·8 and 11 pounds in quite a uniform manner during the following years, except in the disturbances of the second dentition at about the age of six years. A like trouble occurs, although to a less degree, at the time of the appearance of the first tooth, at the age of eight months or thereabout. The influence exerted upon the development of the weight, as upon that of the stature, by dental evolution, is therefore clearly affirmed. It seems that for such transformation, which directly modifies the nutrition, the organism takes a season of rest and preparation, and accumulates reserve material to be employed in this important work. That is why these dates of more active work in the process of growth must make a figure in the history of the organic development of the child.

The first definitive tooth having been cut at the age of six, the growth resumes its regular rate and makes nearly the same progress for years, until puberty. There is a mean increase of more than six pounds for the seventh year, a little less for the eighth, and still less for the ninth, etc., with the diminution of rate already observed in the stature. But the parallelism is far from being absolute. It might be said at the most, if we desired to compare the two series of figures, that the course of one recalls a geometric progression, while that of the other recalls an arithmetic one.

Moreover, the parallelism ceases abruptly at puberty. At this moment the oscillation is, sum total, quite feeble in the stature, but enormous in the weight.

The impulsion is such that, for two or three years, the increase nearly doubles that of the preceding years; then all gradually re-enters the mean, and, starting from the fifteenth year with girls and from the eighteenth with boys, the increase, which is slower and slower, diminishes up to the age at which everything is fixed for maturity, except when obesity intervenes.

This important transformation is, however, far from assuming the same aspect in all. According as the previous preparation, which seems to be the necessary preliminary of this sort of moult, has been more or less favorable, and according as the organism by an intelligent economy has reserved for itself a strength of energy sufficient to take this difficult step, the transformation is more or less rapid, and doubtless also more or less happy. So, while a well developed and well nourished organism surmounts the difficulty with a rapid and easy gait in a few months, feeble organisms, on the contrary, lag behind and desperately lengthen the halts, as if to acquire new force at every instant.

It takes years to awaken humanity in them. On this subject there is nothing more interesting to consult than the statistics of Bowditch upon the sons of artisans and plain citizens at Boston. In these, we discern, through the complexity of causes that modify the growth, the influences of which we have just spoken.

But adolescence having arrived and the transformation having once been accomplished, the organism resumes its ordinary condition, or rather the impetus gradually relaxes, the rate of increase progressively diminishes, and, during the last years that precede the twenty-fifth, scarcely any increase is observed. The proliferation of the cells, and their productive and creative activity, which, at the beginning, everywhere increased the number of the living elements, has now fallen so low that everything limits itself to a struggle for maintenance instead of a production of growth. The organism no longer develops, and is now complete.

The Rhythms of Growth.—What general idea is evolved from an examination of all these figures may be seen without any trouble.

The organic development of the child does not proceed with a uniform and always equal gait, but far from it. There are abrupt fits and starts that terminate in slow periods of repose or preparation. When we study the succession of such periods, their alternations being nearly regular, we see that they obey a sort of rhythm. In the formation of the child there are privileged epochs alongside of others that are less happy; and all this is determined in advance. Thus, it is toward the seventh year, and, later on, toward the twelfth and thirteenth years that the growth is most rapid, while the vicinage of the sixth and eleventh years is marked by true depressions. Are such shocks and alternations, which are grave enough to attract attention at first sight, anything more than a resultant of multiple variations minute enough to be swallowed up and lost in the ordinary course of life?

The first researches that we remade gave but general results; but afterward, through more precise researches, these great oscillations, distributed over several years, were seen to reproduce themselves in the same way, on a smaller scale, in the course of months and weeks, and even through the hours of the day, as if each fragment, with respect to the rest of life, was a reduction or a preparation.

Thus, growth is not the same in autumn as in spring, and the weight does not increase uniformly in winter and summer. There are three different periods of increase in weight every year. The best extends from the beginning of autumn to the middle of December. Progress is slower from the end of December up till April, and during the following months there is a period of almost complete repose.

The alternations are the same with the stature, save that they are otherwise distributed, since the periods of repose correspond to the months in which rapid increases in weight occur, and inversely. Thus, the height increases but very little from August up to November. Its increase is still light up to the middle of March; but from that date up to the month of August the child increases so rapidly, on the contrary, that this period is as good as three times that of the autumnal sleep, after which there is a new rest.

Nevertheless, as it is a question here especially of measurements made with students, it might be asked whether the academic periods, vacations, etc., are not the true causes that thus modify the general rate of growth. But, in the first place, variations in opposite directions in the weight and stature cannot depend upon these uniform causes; and that alone would suffice to make us greatly attenuate the influence of the academic period, even had we not found the same oscillations in children that are not affected by the same causes. It may therefore be concluded that we have here in presence something more than a peculiar case, in fact, a general law that manifests itself under other circumstances.

It is not only the seasons that act thus. M. Malling-Hansen, carrying the analysis still further, has shown that the course of the month, the alternation of the days during the week, and the succession of the hours in the day make themselves felt upon these variations in weight and stature. Thus, the variations above noted are merely the amplification of smaller oscillations. The weight diminishes during the night hours; the stature, on the contrary, increases, and it is the inverse during the day. They are slight fluctuations, it is true, since they are reduced in the adolescent, one of them, to 0·4 of an inch, and the other to 15 ounces; but they have been observed to reach 4·4 pounds in the child.

Further, it would seem that the epoch of birth has an influence upon the vital development of the individual for his entire life. Boys born from September to February will not grow so well as those who come into the world between March and August. With girls, on the contrary, the privileged epoch extends from September to February. So much complexity is there when we reach the details in this apparently so easy and simple a question.

In order to explain these decrease variations, Malling-Hansen has proposed a theory that has been much criticised. Comparing these fluctuations in the motions with the temperature and the modifications introduced into the manifestations of life by the oscillations of the seasons, the Danish pedagogue concludes that the solar motions, directly influencing the temperature, influence also the organic growth of the child through it. Hence all those rhythms that have just been noted, and to which it is of importance to pay attention if it is desired to watch over and direct the physical development of a child.

Although under a somewhat astrological form, the idea, nevertheless, merits more than a hostile reserve. After all, it merely more broadly interprets observations of which the number is daily increasing. Is it not well known that the pulse varies in amplitude, form, and rapidity at the different hours of the day? Barometric heights, indices of atmospheric states that influence the blood pressure, as well as the general state of man, oscillate also, through causes as yet unknown, at various moments during the day; and to these facts we might add others of the same kind, were they only the curious tables recently published in order to show that certain hours invite death, and others birth, etc. All this well shows by what diverse influences organic growth, and, with it, the moral formation of the child, undergoes the contre-coup. It is only an improvement, through facts, of the theory of the influence of the surroundings.

Upon the whole, under all the diverse influences, there is a new factor that comes to counterbalance heredity and its development. The child, like everything that lives, is the bringing into play of certain predispositions that make him what he is and that must manifest themselves according to the individual formula of their subject; but this child lives in a medium and under certain conditions that will necessarily modify the course of such heredity. Its actual growth results from this double influence. Whoever should know its exact value, in each direction, might almost be able to determine its physical and moral results, and say also how the individual shall reach the ideal equilibrium of a proper growth. The elements of the stature and weight represent, however, only a portion of these data, of which the others remain up to the present scarcely indicated. All that can be affirmed just at present is that they exert profound actions upon each other, mutually retarding and activating each other, as they do in the adult, moreover, in order to balance the growth acquired. The general growth is merely the synthesis of this whole.

II.

Our nervous system is rightly considered as the immediate organ of mental life, and that which presides over the nutrition of the entire body. It is, therefore, the study of this, more than that of any other element, that will permit of understanding the physical and moral growth of the child, since it is both its mental organ and the regulator of all nutrition. Its development, which seems to precede that of all the other tissues, differs therefrom profoundly.

In the osseous, muscular, or other tissues, growth always takes place through a multiplication of cells, each of which divides into two or four others, which divide in their turn. This is quantitative increase. It seems, on the contrary, that, in the nervous system, qualitative increase is the more important. From birth to maturity, the number of nervous cells increases but little, if indeed it increases at all; but their qualities change, or, more correctly speaking, while some that are inert and sterile remain forever embryonary, others develop and become complete cells in measure with the requirements of the organism. It is, therefore, necessary to be attentive to other changes that are at least as important, as well as to the increase in number and weight, since at the moment at which the proliferations of nervous cells are arrested, there begins an operation designed to finish a growth that was but imperfectly begun.

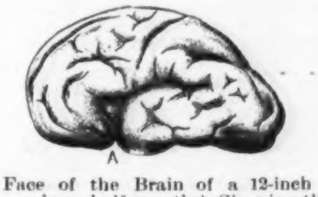
Nervous proliferation ceases at the fourth month that precedes birth. While all the other cells are in course of active proliferation for more than twenty years, the nervous cells, which will preside over these multiplications, cease to divide in order to reproduce themselves. Their growth will thereafter consist in direct increase in volume and intimate modifications in the constituent form and elements. Until then they were merely embryos of adult cells that failed to awaken to active life and become perfect.

Growth in Weight and Volume.—This double work begins at uterine life, in which the brain of the embryo is composed of two kinds of cells, one kind small, incompletely developed and not yet acting, and the other larger and better formed and provided with all the elements necessary for organizing nutritive actions and performing the part of sensitive and motor cells. They are capable of acting, and doubtless already do so.

Toward the epoch at which the numerical increase in the nervous cells is arrested the brain of the embryo weighs about 1·5 ounce, say about a fifth of the total weight of the body at the fourth month. This is quite a high ratio of the brain to the mass of the body, but one that will progressively decrease, since the cellular multiplication of the other tissues augments the weight of the other organs more than does the increase in dimensions and quality of the few nervous elements that continue to grow. From the fifth to the ninth month, the cerebral mass amounts to about twelve ounces in a body of 6·6 pounds at birth, this being a little more than a tenth of the total weight. But at the end of the first year the weight of the body has tripled, while that of the brain has hardly more than doubled, and will not triple until its fifth year, the epoch at which the weight of the body will have quintupled. The divergence becomes marked in the two succeeding years, the cerebral growth falling behind that of the rest of the body to such an extent that at the end of growth the weight of the brain has scarcely quadrupled, while the body is twenty-one times heavier than it was at birth. And yet the cerebral energy has increased more and more according to the ascensional movement of the weight, while its mass has increased nearly like the line of height. Do not profound transformations in the very quality of the nervous elements then intervene?

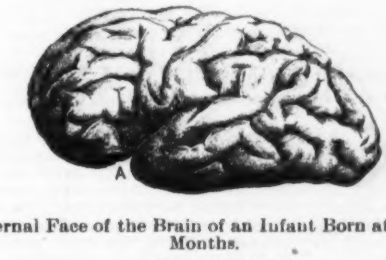
External Face of the Brain of a Human Embryo of 4·8 Inches (three months). (Actual size.)

External Face of the Brain of a Human Embryo of Four Months.



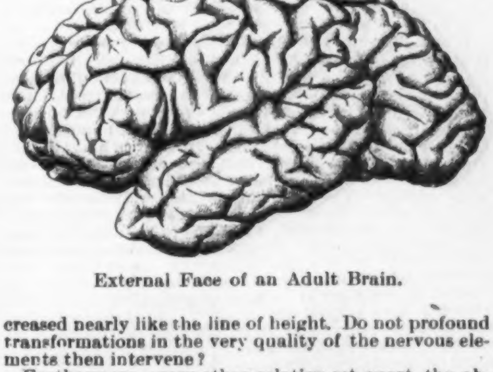
External Face of the Brain of a 12-inch Embryo (twelve and one-half months), Showing the Primary and a Few Secondary Fissures.

A, fissure of Sylvius.



External Face of the Brain of an Infant Born at Seven Months.

A, fissure of Sylvius.



External Face of an Adult Brain.

Furthermore, every other relation set apart, the absolute weight of the brain ceases to increase, and might even diminish toward the fifteenth year. This, however, is the age of adolescence, in which the growth of the rest of the body, far from being finished or arrested, makes the most desperate efforts finally to finish the structure of the organism in all its details. As for mental progress, this is, perhaps, its best period, especially for the acquisition of images.

How, therefore, can we explain this apparent paradox if profound transformations do not then intervene in the nervous qualities? It is by studying these principal developments that we shall be able to understand the form of nervous growth.

Growth in Qualities.—Without having succeeded in completely or constantly following this, we have a few ideas concerning it. We know that of the few million nervous cells that go to make up the brain, about 50,000 are already completely developed at the sixteenth week. At birth, that is to say, toward the fortieth week, the number will exceed 100,000. In the adoles-

cent, more than 200,000 cells act, and in the adult, about 220,000. Is this not a minimum difference between these so profoundly separated ages? We shall find it slighter upon reflecting that such increase in volume, much greater than the multiplication in number, nevertheless expresses as yet but one side of the improvement of these delicate organs, and is only the material from which other finer and more delicate improvements and transformations are to be made. M. L. Manouvrier has well demonstrated that, with the brain in general, quality is of more importance than weight. It seems that this is applicable also to every cell.

GROWTH IN VOLUME OF NERVOUS CELLS.

Fourth week	1
Twentieth week	17
Twenty-fourth week	31
Twenty-eighth week	67
Thirty-sixth week	81
At birth	124
Thirty years	160

$(1 = 700\,\mu^3)$

As far as can be judged at present, the increase in the nervous cells consists in passing from the state of a simple granule to that of a complete cell having a nucleus with a nucleolus and immersed in a well characterized cytoplasm. This evolution, which completes the increase in volume and weight, begins toward the thirty-fifth week, that is to say, upon the eve of birth; but it is far from reaching all the regions alike. There are, in the first place, a few cells of the deep layers that begin to assume this perfect form, and then, after them, the same work goes on in succession in layers that are nearer and nearer the surface. The development thus takes place very quickly from the center to the periphery, so that at birth there are perfect cells at

A B C

Comparative Development of the Nervous Cells.

A, at the seventh fœtal month; *B*, at birth; *C*, in an adult.

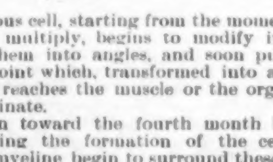
all stages of the brain save at the extreme surface, where the primitive form exists, even in mature men.

Parallel with such increase in the nature of the elements (and doubtless likewise in the chemical composition, as seems to be indicated by variations in reaction with coloring materials), we observe other signs of maturity, such as changes of form, nucleolar modifications, etc.

The nervous cell, starting from the moment at which it ceases to multiply, begins to modify its contours, elongates them into angles, and soon puts forth an elongated point which, transformed into a cylindrical axis, finally reaches the muscle or the organ in which it is to terminate.

It is again toward the fourth month before birth that, finishing the formation of the cell, the first sheaths of myeline begin to surround these cylindrical prolongations, in the first place in the marrow. The completion of the cerebral cells will occur later on.

The appearance of these sheaths of myeline is one of the first facts, duly established, through which we are able clearly to connect the appearance of certain organic functions with visible modifications of the nervous system. They appear, in fact, only at the moment in which, the anatomical connections being established, the nervous fiber is capable of fulfilling its functions of conduction. To say that the axial prolonga-



Nervous Cells.

A, at birth; *B*, at ninety years; *N*, nucleus.

tion has provided itself with such envelope is tantamount to saying that the cell is thenceforward perfect and ready to operate; and the day on which we shall know the date of appearance of these sheaths in all parts of the nervous system we shall have a chronology of the dates at which each of these parts is completed.

It is in the marrow that first appear the complete cells provided with all their accessories—those that constitute the peripheric nerves. It is here, too, that we remark the first reflex acts, the simplest motions of the embryo, along toward the fourth or fifth month of uterine life. Later on in the embryo of from 15 to 16 inches, myeline appears in the fibers of the columns of Goll, and the peripheric excitations are then transmitted over the entire extent of the spinal marrow as far as to the lower parts of the medulla oblongata. Finally, at the eighth month, the fibers of Gower's fasciculus, which ascend to the upper gray masses, as far as to the optical layers and the cortical substance, become myelinized. The central sensitive passage is then open, and the wholly physiological impressions, which were previously incapable of causing anything but a medullary reflex action, comprise thereafter a psychical time—a moment at which the child will be able to take on a rudiment of reflexion in order to organize its response. It is in an embryonic and wholly imperfect form, the first rough draught of what later on will be the thought of man.

Mental life thus begins before birth, and the child that comes to light, before even opening its eyes or ears is not the tablet for inscription or rather the blank leaf that certain philosophers imagine for the convenience of their theories. It has already felt, reacted and thought in the physiological sense of the word, and it is upon these first data that are organized in its brain the sensitive and motor centers between which will stretch those fibers of association which are as yet but imperfectly known, despite the researches of Flechsig.

It is unfortunately impossible, in the present state of our knowledge, to follow such transformations step by step, or year by year, as has been done with the stature. All that we can say is that this entire organism of marvelous complexity and beautiful adaptation is methodically and surely formed in measure with the needs of the organism. The child learns to move its arm in measure as is delineated the complete organization of that part of the brain in which will thereafter be located the motive center of the arm, and reciprocally. It becomes capable of walking in measure as the cells of the cerebral center that preside over the motions of walking act, etc. And so will all our acts, in measure as what was but a virtuality in power in the shapeless cells of the embryo passes to the act and realizes its latent energies through its force of growth.

III.

From all these researches, there seems to spring forth an idea that it is well to bring into prominence, and that is that growth does not make a uniform and regular progress and proceed in the same manner from infancy to youth; but far from it. Under the various influences that cause it to vary, the curves that represent it offer stoppages and extensive oscillations and give abrupt periods of slow repose or of intense activity. At least this is what further and further results in measure as we learn better how to determine things with precision from researches upon weight and stature in growth; and, as these are at present the most advanced, it is permissible to anticipate analogous results from other researches, after they shall have reached the same point.

It has been necessary, moreover, that the influence of these periods in rhthym should, despite everything, make itself felt in the calculations, in order that they might not disappear through being swallowed up in the flood of averages. In fact, in certain calculations, in which they appear, despite everything, the figures from which they are evolved are naturally derived from measurements made with groups of children numbering several tens of thousands (witness the statistics of Bowditch). Now, since the reference adopted is always the age, and since, on another hand, the various children of one and the same group scarcely ever experienced their impulsions of growth at the same epochs, such periodical oscillations had to be very evident in order to appear despite all; for in the manner in which the averages were established, everything tended, on the contrary, to make such divergences offset each other and disappear in uniformity.

Now, this law enunciated, will it not be necessary hereafter to proceed otherwise if it be desired to make prominent other facts more delicate and not so easy to reveal? It would seem so, especially if we reflect that age is, after all, a wholly secondary coefficient of development. Such a child of sixteen years may be more perfectly developed than his companion of eighteen. Shall we apply a common measurement to both or blend their individual differences in an average? But in what way will this means permit us to presage, in order to correct, the growth of a child whose development we wish to watch? Who is there to tell us that it belongs to the type of the child of sixteen rather than to that of eighteen? At all events, it certainly does not depend on an average, which is a pure abstraction, a representative ideal of seventeen years—between 16 and 18.

That is not all; the question is complicated further still by the fact that not only all children have not the same stature and do not have their impulsions of growth at the same dates, but tend, each on his own account, toward a different stature. Let us understand by this the simple fact that all adults have not the same stature. In fact, the difference, as every one knows, is sometimes very great. Therefore, why should we refer to a common measurement the growth of a person whose stature will not exceed 5·25 feet and that of his neighbor who is destined to reach the stature of a cuirassier; or rather, why get around the difficulty by taking an average, which corresponds to neither stature? We think it would be possible to proceed otherwise, by according to the figures of the age, stature and weight only a secondary rank and reserving the pre-eminency for some more characteristic sign of the periods of growth. Dental evolution seems to be at present the best known of such signs, the teeth having the advantage of very exactly reflecting (to him who knows how to study them) the heredity and almost all of the previous diseases of the individual. They are easily and quickly examined, and the phases of their development are now accurately enough known to permit of finding in them the expression of that of the rest of the organism. It would therefore be desirable that, giving an examination of them more importance than in the past, a standard of growth should be established. Instead of solely noting that A weighs but 44 pounds at five years of age, while B weighs 48, we should make our knowledge of the future of these children particularly accurate by adding that A already possesses his six-year tooth, while B shows no signs thereof.

We shall thus know that, despite the apparent inferiority in weight, A is in reality further advanced than B, and such a fact is of importance to know with accuracy before all else in order that the rearing of both may be properly directed.—Dr. Jean Philippe, in Revue Larousse.

SVEN HEDIN'S TRAVELS IN THIBET.

By H. L. Geissel.

Sven Hedin, the famous explorer, has written a personal letter to King Oscar of Sweden and Norway. The letter is dated Abdal, at the mouth of the Tarim River, June 20, 1900. The traveler says that he had established his headquarters at Jañgi Köll, where all his baggage and the great bulk of his caravan was stationed. From that place he made a dangerous journey through the Tjert-jen Desert, and on March 5, 1900, he left again, with a caravan consisting of five camels and five horses, two dogs, a Cossack, four Mussulmans, and a hired caravan, eastward, to cross those parts of the Gobi Desert where he hoped to discover the ancient Lake Lop-nor. He followed the southern slope of the Kurruktagh Mountain chains, whence he descended to the desert proper. His caravan kept close along the great dried bed of a river, which the natives call Kumdarja, or desert river. The existence of this river bed, which at two points was touched by the Russian explorer Kosloff, the traveler points out, is of the greatest interest, as it proves that the Tarim formerly had quite another course than at present. "I was absolutely convinced," Sven Hedin continues, "that if I followed the course of this river bed, it would lead me to that place I was longing for, to the former Lake of Lop-nor. The most difficult and dangerous task of our journey lay in the fact that pasture for the camels and water was only available at two points in Kurruktagh Mountains; thus there was nothing to be done but to ascend to these springs. At the first one, the Jardang-bulak, we remained three days. Its water is bitter and salty, but below the spring it lay frozen in large blocks free from salt, and so easily accessible that without difficulty we could load some camels with it. This enabled us to descend to the river bed, which we then followed for six days in an eastern direction, the distance we had to travel to reach the next spring, the Altimisch-bulak. On this journey we met numerous wild camels, which, as a rule, remained at the foot of the mountains or in the desert, but went from time to time to the sheltering springs to drink and graze. It affords a splendid sight to surprise such a herd. Some of them usually remain standing, like scouts, while the rest repose in a lying position. In the neighborhood of Altimisch-bulak our guide, Abdu Rehim, killed one of these huge animals, whose existence up to our own times scientists had doubted. There are Mongols as well as Mohammedans who live exclusively upon the hunting of wild camels in Kurruktagh and the districts further east. I had the good luck to meet one of these hunters, Abdu Rehim, who rented us his nine camels and who himself, after he had accompanied his sister to the little village of Dural on the lower Tarim, where she was promised to a man of Turfan, was about to return to his home in the mountains. This man possessed an astonishing knowledge of the whole district and gave me much highly valuable information."

Sven Hedin then describes the process of his journey, during which he met a terrible buran, the black storm, which compelled the caravan to halt and build shelter, which was done under the greatest difficulty by erecting a tent tied to dry roots. "At the surface of the earth," the traveler says, "the wind had a velocity of 18·1 meters per second, but at a height of only two meters this amounted to 26·6 meters. In order not to be blown away, we had to kneel down. The men crowded in their furs around our fire; the thermometer indicated 7° below zero, and the cold was severe." Sven Hedin thinks that the wind in those parts of the world is the strongest physical power working at the transformation of the earth's surface, and finds it explainable that through these frequent burans Lake Lop-nor has been blown away, and that the great river had to leave its old bed to take a more southerly course. Sven Hedin then continues: "Altimisch-bulak was the last place where we could get water before reaching the lakes of the Karakoshun in the south, and here too was where Abdu Rehim with his camels was to leave us. I succeeded, however, in persuading him to accompany us for two more days with his animals, six of which we loaded with ice. The next day we reached the shores of an ancient lake with large salt deposits, dead forest and reed, and the entire second day we marched over its bottom, which consisted of a layer of clay lime with thousands of millions of clamp-shells, linnaca, the same kind as now live in the lakes of the Karakoshun. Into this lake the dry river bed enters. It lies exactly on the same spot on which the Chinese charts place Lake Lop-nor, and in its left extension there are situated the lakes which I discovered in 1896, which I then correctly declared the remains of the ancient lake.

I was more than delighted over this discovery; though the Russian geographers still are of the same view taken by Pryhevalsky, I am now absolutely convinced they are wrong. The ground of the lake has been strangely furrowed by the northeast storms; it is crossed by clay hills from two to three meters in height. We proceeded the same day in a northwesterly direction, and the next day discovered remains of ancient dwellings. Two curious buildings must have originally stood there. One of them must have been a Buddha temple, as we found numerous small offering-vessels. The doors, which were pretty well preserved, showed peculiar carvings. The latter represented a king with crown and scepter, an upright man with a wreath in his hand, flowers, garlands, etc., all of which was skillfully executed. The other building was rather a row of dwellings or rooms, with a length of fifty-two meters, and might have been an old Chinese hotel. It was built of solid wood. To the east, in a distance of about half a mile, we noticed four white clay pyramids, which I visited. Their high domes were massive; one was provided with gates and portholes. They doubtless served as landmarks and watch towers and there is every probability that one of the ancient roads, a caravan route, which connected China with the Occident, passed by here. On that day, March 29, the explorer states, Abdu Rehim returned with his camels to the mountains,

thus reducing Sven Hedin's caravan to four camels, one horse, two dogs, and four men. Three horses had perished. After surveys had been made, the best carvings were taken along, and the caravan proceeded southward. During the next day, nine more dwellings were discovered. The woodwork was carved in the same way as the above mentioned, and the best pieces were taken along. Soon afterward the caravan reached a salt water lake; no vegetation was to be found around it, and Sven Hedin thinks that it was a newly formed lake. Proceeding further south, the caravan arrived at the shores of the Karakoshun, where, on splendid pasture ground, abounding in fresh water springs, a halt of two days was made. From that point the return to the headquarters was made in canoes. The headquarters were reached after about a month's travel, on May 8. After a rest of a few days, Sven Hedin started with the whole caravan from Jañgi-Köll by way of the river to Abdal. He concludes his letter by stating that he will leave the main caravan at Abdal, and will go with a small escort to the mountains. He then intends to make journeys from Abdal with light caravans through Northern and Central Thibet. In the autumn he will go to the Mongols in Northern Tjadjam, and return once more to the above mentioned ruins in the desert south of Altimisch-bulak. He intends to leave his main caravan during the winter (1900) in the small town of Tjarkhlik, whose Chinese ambam is an old acquaintance of the explorer. His next report, he says, will be sent in November to Kashgar.

THE SCOTTISH NATIONAL ANTARCTIC EXPEDITION.*

By WILLIAM S. BRUCE, F.R.S.G.S.

MORE than half a century has gone by since any great interest was taken in the Antarctic regions. Indeed, people seem to have forgotten that there is an area round about the South Pole, greater than that of Africa, about which we practically know nothing. During the early forties there were no less than three expeditions with six ships representing America, France, and Britain, exploring in the Antarctic at one and the same time, and until recently no further exploration work has been done. The "Challenger" crossed the circle in 1874, and the Scottish whalers carrying scientists and an artist with them in 1892-93 worked for three months in the pack in the vicinity of Erebus and Terror Gulf. Last year a Belgian expedition, under the leadership of Lieut. de Gerlache, returned to Europe after being the first human beings to spend an entire year within the Antarctic Circle, and bringing back a rich series of scientific observations.

This year Sir George Newnes' expedition, under the leadership of Mr. Borchgrevinck, has returned, having supplemented the work of the Belgians by bringing back records of a second winter in the Antarctic. Next year, if all is well, at least three expeditions will set sail. The first of these is from Germany, the other two are from the United Kingdom. Scotland is making a special effort, in that she not only partakes in the honor of contributing her share to the British ship, under the command of Lieut. Scott, R.N., but in that she is sending out a second vessel on her own account. Several eminent geographers have advocated such a course, among others, Prof. Erich von Drygalski, leader of the German expedition, who says that "an expedition from a third side would find a wide and important field of activity to the south of South America." The Scottish expedition will co-operate with the others, but while magnetism forms the most important feature of the German and British expeditions, it will devote itself more particularly to physical and biological oceanographical researches, and to geology and meteorology.

Germany will concentrate her attention to the south of the Indian Ocean. "The point which the German expedition has in view for commencing the penetration of the Antarctic region is the still hypothetical Termination Island." An effort will be made to establish a station on land to the southward of this. The main work of the British expedition will lie in M'Murdo Bay at the foot of Mount Erebus, their winter headquarters, and the adjacent coasts or ice barriers for a considerable distance on each side. The Scottish expedition will work to the south of South America, setting up its wintering station on the east coast of Graham's Land, as far south as is desirable.

The Scottish vessel will be one of the ordinary Norwegian or Scottish type of whalers, about 500 tons, with auxiliary engines. The proposed staff includes 6 scientists, 5 ship's officers, and a crew of 26. The ship will proceed from Scotland on August 1, 1901, to Port Stanley, in the Falkland Islands, which will form the base for operations in the Antarctic regions. Thence she will head southward by Weddell's track in 30° west. This route has never yet been tried seriously with a steamer. Weddell, in 1823, penetrated far south with two sailing ships, one of 120 tons and one of 65 tons. Bellinghausen also was successful a little further eastward. Ross, with sailing ships, failed; but Larsen, with a steamer, reached 68° south in about 60° west. The Dundee whalers, in 1892 and 1893, being on commerce bound, were chiefly occupied killing seals, and since these abounded in the vicinity of the Circle, they had no need to go further south. There is little doubt that the ice can be penetrated by such a vessel as that above mentioned. The ice I saw in 1892 and 1893, and worked among in 50° to 60° west in neighborhood of the Antarctic Circle, is very similar, and is certainly not so heavy as East Greenland ice, in which ships like this one navigate every year.

The writer will take command of the expedition with a whaling captain under him and four other officers. A naturalist will be permanently attached to the ship, and will take charge of and carry on the scientific work there during the leader's absence with the wintering party. The land party will land in a high latitude on the east coast of Graham's Land, and the ship will return northward for the winter.

The land party will consist of five scientific men and two skilled workmen. The leader is included in this number. Systematic observations will be taken and collections made. The ice, both on land and sea, will be studied—its physical state, the movements of glaciers, salinity, etc. In the spring sledge journeys with dogs will be undertaken for topographical and other purposes. I have seen fast land floe ice in the Antarctic that could be traveled over with dogs, sledges, and ski; and I have no doubt that useful journeys could be made on the inland ice. In 1902 the ship will return south to relieve the wintering party and to resupply it with fresh food. If there is occasion and opportunity, further exploration will be made with the ship in the summer months in that region, before she returns northward for the second winter. A second winter will be spent at the station, and a final return made during the third year, unless funds allowed the expedition to stay another winter.

Modern expeditions, whatever unknown part of the world they intend to explore, must not be content merely to cover great stretches of land or sea; they must concentrate all the powers and resources of civilization and science in bringing back a complete and detailed record of the parts they visit. To go to the South Pole and back again is of no value beyond being an athletic feat, but to carefully survey the land, sea, and atmosphere in a definite area in the south polar regions, and to bring back complete records of every description, is of the greatest possible value, and is what is required of every south polar expedition.

So vast is the unknown area of the Antarctic that there is room enough for many more expeditions than those that are setting out next year from Europe. This is emphasized when we recall that as many as five expeditions have been wintering in the much explored Arctic regions during the past winter, and that there was still room for others. It is to be hoped, therefore, that other countries, America and Norway, for instance, will join in this great international piece of work.

Many important problems will be presented to the Scottish expedition along the route it intends to follow. The voyage to the Falkland Islands will be made as quickly as possible. The first stop will be to coal at the Cape de Verde Islands, after which a course will be steered for a point almost half way between Trinidad and Ascension Islands, nearly a thousand miles east of Bahia, on the Brazilian coast, where Ross did not reach the bottom with 4,600 fathoms of line. This sounding has been overlooked by cartographers, only appearing, as far as I am aware, in one chart of the South Atlantic. A sounding will be made in this place to prove or disprove the accuracy of Ross's sounding, which up till quite recently was the greatest depth recorded in the oceans. Should the weather remain favorable, other soundings will be made in this little known "deep." Besides adding important facts to our knowledge of the bathymetrical survey of the Atlantic Ocean, this will enable us to test the capabilities of our deep-sea gear to its fullest extent, thus bettering our researches in the south. As fast a passage as is possible will then be made to the Falkland Islands, where a few days will be spent taking a final supply of coal on board, as well as fresh mutton, beef, and other provisions. Throughout this part of the voyage as many observations and collections as possible will be made, without stopping the ship, in meteorology, in physical observations of the surface of the ocean, and in planktonic and necktonic collections.

After leaving the Falkland Islands a course will be steered until longitude 30° west is reached in the vicinity of the Sandwich group; this point should be reached on or about November 1, 1901. It is possible that a line of soundings running southward will be taken at this time along the meridian of 30° west, which will be of extreme interest in relation to Ross's sounding of 4,000 fathoms, no bottom, in latitude 68° 34 minutes south and longitude 12° 49 minutes west, and to the deep soundings taken by the German Deep-Sea Expedition in the ship "Valdivia," between Borwet and Enderby Land. During this season, however, the primary piece of work will be to push southward in this longitude to a high latitude and establish a wintering station. Possibly a latitude of 80° south may be attained, or if the coast line of Antarctica be not met with in that latitude, the ship will push southward as far as the ice allows, till land is reached. No sacrifice of the ship, or of scientific work and records, will be made in attempting to reach the South Pole, but failing to find land south, a course will be steered westward to strike the southern continuation of the east coast of Graham's Land, where the station will be set up.

After the house has been built and provisions for three years landed, as well as scientific equipment and the seven winterers, the ship will hastily retire before winter sets in to gain the open sea and the Falkland Islands. Here officers and crew will rest and recruit for a week or so, in order to continue with vigor the work that will have to be done during the winter months, before returning to relieve the high latitude station in the spring—namely, November, 1902. The ship will not winter if it is possible to avoid it, for by so doing she becomes a hulk to all intents and purposes, whereas if she is free she can be carrying on oceanographical researches in the open sea in unknown and moderately high southern latitudes, and be visiting islands which lie in her track. At the end of the winter the ship will call at Buenos Ayres or Port Stanley, and, after being overhauled, another two years' provisions and coal will be taken on board for the high latitude station in addition to the three years' provisions landed the previous season. Thus the winterers will be perfectly secure for four more years should the ship find it impossible to reach them again during the next or following three years—a circumstance which, though possible, is scarcely probable, yet must be provided for. There will, no doubt, also be a plentiful supply of food near the station, seals, penguins, and other birds forming excellent and nutritive food as well as fuel.

As long as the season will allow, the ship will explore in the vicinity of the station during the second summer. Sounding, dredging, tow-netting and all kinds of marine physical observations will be carried on. Again, the ship will not be allowed to winter, if it is possible to avoid it, but will return northward to continue similar work to that she was engaged in during the previous winter. The winterers will once more set to work with serial station observations in meteorology, magnetism, and terrestrial physics and local topographical, geological, biological and other work during the second winter and spring. In the third summer the ship will again push southward, and the whole expedition will return home unless the welcome news comes that funds sufficient for a third wintering have been secured. On the homeward voyage the expedition will complete, as far as possible, the accurate survey of the east coast of Graham's Land, and the bathymetrical survey between that coast and about 30° west longitude.

The difficulties of transport will necessitate the house being small; it will be of Russian construction, built of logs. There will be double windows and doors, all properly secured against cold, which, as far as we can gather, will not be more intense than that experienced in certain inland parts of Russia. There will be one main compartment and two or three smaller ones. Besides this there will be magnetical and meteorological observatories and store-houses for provisions and gear and properly sheltered accommodation for forty dogs. The station will be lighted by electricity.

The great value of such an expedition at the present time is that it will not only secure a number of highly interesting and important observations in the Antarctic, but that these observations will enhance and be enhanced by the observations being carried on at the same time by the German and British expeditions on the Indian and Pacific sides of the Antarctic. The Scottish station completes a triangle of stations round the South Pole, a condition very favorable, and, indeed, almost indispensable for researches in meteorological science.

I have been assured by the leading members of the councils of most of the learned societies of Scotland that they will constitute a committee of advice, to which all questions concerning the details of the organization and scientific work will be submitted. The cost of the expedition on the lines indicated will be £35,000, of which about £10,000 has already been secured. Many have expressed their pleasure in hearing of a Scottish Antarctic expedition, and among them Prof. Erich von Drygalski, who says: "Wishing the best result to the endeavors made in this direction, I shall be very happy to allow the German expedition to co-operate with the planned Scottish one."

The plans have been long considered, and I have consulted with many of the leading authorities in Europe while maturing them; notably I may mention His Serene Highness the Prince of Monaco and Sir John Murray. They are based on the experience I have gained during one summer I spent in the Antarctic regions and during four summers and one winter in the Arctic regions and during cruises with the Prince of Monaco and Mr. Andrew Coats, doing deep-sea sounding and dredging, as well as on my experience during more than a year on the wintry summit of Ben Nevis, where I was in charge of the observatory.

* The Independent.

HEAT UNDER ALPINE SNOW.

WHAT makes the Simplon tunnel chiefly interesting both to engineers and the uninitiated is not the fact that it will be the longest of its kind in the world, but the employment of radically new methods in its construction, says The New York Tribune. These were adopted, moreover, for a reason that few would ever think of. Cutting a hole through granite is not now so serious a difficulty as dealing with the heat that is encountered in a mountain tunnel when it has attained a certain length.

It is well known that the air grows cooler with ascent, similarly, the air gets warmer as one descends; and if, instead of going down from a level surface, as in the copper mines of Lake Superior, one simply pushes ahead horizontally into a mountain a mile or so below its crest, the temperature will be observed to rise in the same manner.

During the construction of the Mont Cenis tunnel a maximum of 85° Fah. was experienced, and in the St. Gothard, 87°. It is estimated that for something like six miles of the Simplon tunnel the rock, when first laid bare, will show a temperature of 104°. While the St. Gothard tunnel was being cut no less than six hundred lives were lost among the workmen, most of them indirectly, in consequence of this heat. After engaging for hours in vigorous physical toil inside the tunnel, the men would go out into the Alpine coolness, take cold, and die. But if such results followed the construction of the St. Gothard tunnel, what might be expected of temperatures 15° or 20° higher for a much longer distance? It was this consideration which gave rise to what is the most important innovation in the Simplon tunnel. Improvements there will be, of course, in methods of drilling, blasting and removing the fractured rock, but the chief novelty has been planned for the sole purpose of abating the intense heat that would naturally be encountered.

The other great mountain tunnels of the world, even when designed to accommodate two railway tracks, are single. The Simplon tunnel will really be a pair of parallel passageways, whose centers are 55 feet 9 inches apart. Each will afford room for only one track. At intervals of 200 meters (656 feet), as the workmen advance, they will cut small cross tunnels to connect the main ones. These openings will be closed with doors, all except that which at any particular time happens to be the one furthest in. It will then be possible, by forcing air in through one tunnel and allowing it to return through the other, to establish a fine circulation. For that portion of the heading which is beyond the last door a supply of air will be furnished through a 10-inch pipe by hydraulic blowers. The air will be artificially cooled by a water spray before being pumped into the tunnel. Already this system is in operation at the southern or Italian end, but for the present a different plan has been employed at the northern end.

When a tunnel of this kind has been finished, it slowly cools off inside. The temperature at the middle of the Mont Cenis tunnel is now about 66° or 68° Fah., and in the St. Gothard tunnel between 72° and 74°, and it remains substantially stationary the year round. A like improvement may be expected to occur in the Simplon tunnel, but more speedily than in the other instances, on account of the plan just described.

Still, even after the heat has been disposed of, other evils have been experienced in the past. It has been deemed too costly to cut vertical shafts from the tunnel to the upper air for ventilating purposes. Accord-

ingly, there has been a distressing accumulation of smoke and foul gases from the locomotives. The products of combustion are imprisoned near the middle of the tunnel, because there is an up grade from each end to promote drainage. There is a tunnel in the Apennines, between Bologna and Florence, in which for a long time passengers and trainmen suffered greatly from this cause. On one occasion, when one of the crowned heads of Europe was riding through this tunnel, the engineer and fireman both became unconscious. At length an engineer of Bologna, Signor Saccardo, proposed to try a big ventilating fan at one end of the tunnel. Within a few minutes he reduced the temperature 26° and expelled the smoke and vapor. Since this gratifying result was attained the system has been installed at two other places in Italy and in the St. Gothard tunnel. Preparations are now being made for its introduction to the Mont Cenis tunnel.

There are now three great engineering works of this character in the Alps. The Mont Cenis tunnel, begun in 1857 and finished in 1870, is 8 miles long and cost $15,000,000. It runs from France to Italy, near a straight line drawn from Lyons to Turin. The St. Gothard tunnel, 9·3 miles long, was started in 1870 and completed ten years later. It was designed to open up a short route from Bavaria to Lombardy. It is situated in Southern Switzerland, and emerges into a region that lies between Lakes Maggiore and Como. The Arlberg tunnel lies entirely in the Austrian Tyrol, and is only 4 miles long. It was begun in 1880 and finished in 1884.

The Simplon tunnel is meant to shorten the route from Paris to Milan 48 miles. Its projected path is 12·28 miles long, and crosses from Switzerland into Italy about 35 miles to the southwest of St. Gothard and a scant 100 miles in a beeline east of Geneva. The northern terminus is the village of Brieg, at the head of the Rhone. The southern end will be near Isell, on a tributary of the Toce, which empties into Lake Maggoire on the west. The contractors are to receive about $12,000,000 in payment, although this amount will be varied by forfeits for failure to complete or premiums for completion in advance of the stipulated

FIG. 1.—DIORITE TOMBSTONE, 1756, NEWBURY, MASS.

time. The contract calls for doing the work in five and a half years, and over eighteen months of the time have now elapsed.

SYMBOLIC ROCKS OF NEWBURY AND BYFIELD, MASS.

By HORACE C. HOVEY.

IN colonial times Newbury and Byfield were in the same town, at the mouth of the Merrimac River, thirty-seven miles from Boston. The first settlers were mostly Puritans, seeking liberty in America, and strongly prejudiced against ecclesiastical art. Proof of this appears in the thousands of black slate tombstones imported from Wales and bearing uncouth emblems of ruthless Time, with apt or inapt epitaphs and Scriptural quotations.

Scattered among these grotesque foreign stones are a few that are of diorite, or greenstone, as often called, a whitish rock with greenish-black specks. It lies around the pastures, and usually has one face naturally smooth, rather hard to work by the chisel, and standing weathering admirably. These diorite stones bear singular carvings, sometimes highly artistic, and suggesting a pagan significance rather than one of Christian import. They seem to have been made by one artist, or perhaps one school of artists. These peculiar monuments it is now my purpose to describe. In doing this let me, at the outset, acknowledge my indebtedness to the late Mr. Alfred Osgood, of Newburyport, Mass., who first directed my attention to the subject and gave me much information; and also to his son, Mr. John Osgood, by whose camera the accompanying photographs were taken. I have myself, however, personally inspected nearly one hundred diorite monuments.

The first thing to be noticed is that every stone shows the same conventional human face, unlike any ever found on the slate slabs from Wales. We suppose the original of this unique face to have been carved on a stone exhumed at Byfield, at a depth of twenty-two feet below the surface, and now in the possession of Mr. Eliphalet Griffin, of Newburyport. The face is life-sized; its eyes are elliptical and upturned with an expression that might either be of adoration or terror, and the strongly marked lines of the nose and lips are very peculiar. The photographs are numbered for convenience of reference.

Fig. 1.—This is the most recent specimen noted, being dated 1756. On each side of the conventional face, already mentioned, is a double scroll, symbolic of the rolling up of the past and the unrolling of the future. Supporting each scroll is a disk with straight spokes. Down the edges are successive scrolls. It has a square body surmounted by a semicircular top, as do all the other tombstones of the kind.

Fig. 2.—This has disks with straight spokes each side

FIG. 2.—DIORITE TOMBSTONE, 1736, NEWBURY, MASS.

FIG. 3.—MILESTONE AT DUMMER ACADEMY.

FIG. 4.—MILESTONE NEAR "DEVIL'S DEN."

of the human face, while at each corner are disks with bent spokes, a reminiscence of the chariot of the sun. Underneath the face are emblems supposed to be phallic. The border of scroll-work differs from the pattern observed in Fig. 1. The inscribed date is 1736. These two may suffice as specimens of the tombstones. All have that same remarkable human face, similar disks and scrolls, and none bear Christian signs or inscriptions. Some of the disks have double spokes whose extremities are joined by curved chords so as to make an indented triangle, while other indented triangles fill the right and left corners.

Still more interesting are the old milestones between Boston and Newbury. These, too, are of diorite, and seemingly from the same workshop as the tombstones. The entire series numbered thirty-seven. Most of them have disappeared, being broken up by relic hunters, or used by builders, or worked into stone walls. Those still in existence were prostrate amid the weeds, or buried mid rubbish till quite recently placed upright by those interested in such matters. One found by Mr. Edward Osgood, about four years ago, marks the twentieth mile from Boston, and stands near an old burying ground in Hamilton. It is the only diorite stone known to bear a Scriptural quotation, namely, from Job xxx, 23. Half a mile from it is another that was found by the same gentleman. Both these bear the date of 1710. No photographs were taken, nor can we describe the symbolic carving further than to say that it was like that found on others.

The third milestone discovered is in Byfield. (See Fig.

FIG. 5.—MILESTONE IN NEWBURY, MASS.

FIG. 6.—CORNERSTONE OF 1636.

FIG. 7.—CORNERSTONE OF 1640.

FIG. 8.—BRIDE OF THE SUN (1640?), BYFIELD, MASS.

3.) It was flat amid weeds till set upright to be photographed. It is near the famous old Dummer Academy. Its legend is 5 N(ewbury); 33 B(oston). Date inscribed is 1708. Underneath the date is a triangle within a triangle, a device that, according to Inman, symbolizes a conjugal relation; though it might also have other meanings.

A very peculiar stone marks the thirty-sixth mile from Boston. It is near the "Four-rocks Bridge," and a noted serpentine quarry known as the "Devil's Den." It was originally surmounted by a figure of a

rolling sun, which was broken off by some relic hunter. The block is known to have lain on the ground for forty years before being set upright again in its present position. The singular conventional device underneath the lettering is striking. (see Fig. 4.)

The thirty-seventh mile is marked by a finely preserved diorite standing near the old "training green" in Newbury, opposite the house of the late Stephen Little. It was unearthed and set upright by Mr. William Little, the president of the local historical society. (See Fig. 5.) On its summit is the double triangle. On each side of the letter "B" is an elegant disk with bent spokes. Underneath the figure is a phallic device. On each side of the stone is the legend P(ortsmouth) 26 (miles). Underneath is another triangle.

Now let us visit what might be regarded as the ancient workshop of the unknown sculptor who made or directed the making of all these quaint old diorite monuments, and induced the pious Puritans to set them up, in presumable ignorance of their pagan devices.

The locality in quest was formerly the "poor-farm" of the county of Essex, but was bought by the late Dr. Ambrose, and is now the property of a gardener named Hale. Here and there we find isolated blocks of worked diorite, some of them bearing dates. The door-step of Mr. Hale's house is a specimen, dated 1690. A similar block in the under-pinning of Mr. Hale's barn, dated 1636, carries the emblematic veil festooned from a horizontal staff, flanked by fleurs-de-lis. (See Fig. 6.) In another block, also in the under-pinning, marked 1640, the fleurs-de-lis, if we may style them such, are reversed. (See Fig. 7.) It has been suggested that these blocks are intended to form the base of the triumphant specimen of primitive New England sculpture now to be described.

On this monument the unknown colonial artist expended his resources of genius. It may have been his sign to draw custom. (See Fig. 8.) Mr. Osgood's conjecture was that it represented the bride of the sun-god, whose badge of power was the fleur-de-lis. When found it was in Mr. Hale's cow yard, half-buried and fast sinking out of sight. It has been extricated and set against the wall. It measures about a yard in width and height, and half that in thickness. To handle such a ponderous block and to cut its tough material must have taxed the abilities of the workman. At the top is a rude figure of the sun suspended by four rays attached to the periphery. Fainter rays dart in every direction from it. Many marginal rays converge toward a framed inclosure around that same conventional face that confronts us on the Newbury tombstones; only here, instead of a plain oval contour, the head is decked with puffs and terminal love-locks. Between the breasts is the significant triangle. Outside the frame are the fleurs-de-lis and pointed hearts.

Numerous dioritic blocks, with similar markings, and in varied conditions, lie scattered at random through the adjacent pastures and woodlands. While there is no authentic history of them, they certainly open a field for investigation. The engraved dates run from 1636, a year after the settlement of the colony, down to 1756. After the latter time it became the custom to import tombstones from Wales, ready-made, with a space left blank for inscription.

EDUCATION IN JAPAN.

FROM the twenty-sixth annual report of the Japanese Minister of State for Education, which is just at hand, says Engineering, we learn that the Japanese are relaxing none of their efforts for the development of education in their country, and especially in those departments of science which have a direct bearing on their trade and industry. They do not, however, by any means confine themselves to merely technical applications, for they clearly recognize that without a good basis of general education it is impossible to carry on a successful system of technical education. The year under review in the report witnessed greater progress than its predecessor. Elementary education was extended, and a larger proportion of children took advantage of it, while secondary and higher education were more fully developed. Some years ago Lord Reay, when introducing a deputation to the English Education Department, expressed the opinion that our educational authorities might learn a few lessons regarding the organization of education, if they studied what the Japanese were doing; and we believe that this is no exaggeration.

In education, as in many other things, we go about our work in a very haphazard manner, with the consequence that there is a great waste of energy and means. The scheme of the Japanese, on the other hand, was carefully thought out, and it has been prosecuted with a persistence which to a large extent disproves the charge which is often made: that they are too changeable in their moods to carry out any systematized programme of work. Their normal schools and universities supply the teachers required for ordinary work, while the higher positions are generally filled by men who have gone through a very complete course of training in their own country, and have supplemented it by taking advantage of foreign schools and universities. Special attention has been given to technical schools, which are designed to give instruction in the applications of science and art to trade and industry. The number of schools in this category includes five government, 69 public, and 14 private establishments. Of course some of these are comparatively small, but they all are doing good work.

The Higher Commercial School in Tokio is chiefly designed to give that higher education which is necessary for commercial pursuits, either domestic or foreign, and also to prepare students for the management of commercial and financial affairs either public or private, or to become managers of, or instructors in, commercial schools. The Tokio Technical School is designed to give instruction theoretically and practically in such branches of study as are necessary for technological pursuits, and has an apprentices' school annexed to it. The Sapporo Agricultural College is designed to give superior instruction relating to agriculture both theoretical and practical, the course of study extending over four years. The Tokio Fine Art School has for its object the training of specialists in various arts, and instructors in general drawing; the course of study including painting, designing, sculpture, architecture, and industrial fine arts. The Osaka Technical School is designed to prepare pupils in the various departments of mechanical and chemical technology. Besides these there are a considerable number of apprentices' schools, which are intended for those who are at practical work. Instruction is generally given in the evenings, the afternoons, or on Sundays.

At the head of the educational institutions in Japan stand the two Imperial Universities of Tokio and Kyoto. That of Tokio has grown up slowly, and has been formed by the amalgamation of the special colleges which have from time to time been founded by different departments of the government. The university consists of the University Hall and the Colleges of Law, Medicine, Engineering, Literature, Science, and Agriculture. The College of Engineering includes the nine courses of civil engineering, mechanical engineering, naval architecture, technology of arms, electrical engineering, architecture, applied chemistry, technology of explosives, and mining and metallurgy. The College of Science includes the seven courses of mathematics, astronomy, physics, chemistry, zoology, botany, and geology. The College of Agriculture includes the four courses of agriculture, agricultural chemistry, forestry, and veterinary science. The University of Kyoto was only founded about three years ago. It includes a College of Law, a College of Medicine, a College of Literature, and a College of Science and Engineering. A considerable number of students are sent to foreign countries for the purpose of study and practice. During the year under review, eighteen students were sent abroad to Germany, England, France, the United States of America, Belgium, and Korea; and at the end of the year there were 58 such students abroad, and all of these will be appointed to responsible positions on their return.

HELICAL VACUUM DISCHARGE.

THE new vacuum phenomenon discovered by E. Ruhmer is of considerable interest and is a striking sight. It is best produced in a glass tube 1 mm. long and 4 cm. wide, exhausted so that a discharge from a 30 cm. induction coil just forms a spark of 15 cm. through air in preference to the tube itself. When an industrial current at 110 volts pressure is sent through the tube and a Wehnelt interrupter, a thick red stripe traverses the tube from end to end. On reducing the current by suitable resistances, the stripe breaks up into a series of glowing patches. On placing the tube vertical and grasping it round the middle, so that the anode is uppermost, the patches arrange themselves in a spiral, which slowly turns about its axis, making one revolution in about 7 seconds. The diameter of the screw is about 2·5 cm., and the screw is left-handed. Sometimes the diameter is smaller, and then the screw is right-handed, but in both cases the rotation is such that the wave line appears to descend. The point of attachment at the electrodes remains the same. The pitch of the screw varies with the strength of the current and the rate of interruption. The phenomenon has not been hitherto explained, but it has probably some connection with the warm air current rising spirally in the tube.—E. Ruhmer, Physikal. Zeitschrift, June 23, 1900.

THE FEATS OF A TRAINED DEER.

A GERMAN circus manager, Mr. Albert Schumann, has succeeded in establishing for himself an enviable reputation as a trainer of horses for the circus, according to Illustrirte Zeitung. His horses have excited considerable comment among sportsmen wherever they have been exhibited. He has, however, also successfully trained other animals, which goes to show that his methods are not as rigorous as is generally supposed.

The trained deer shown in our illustration give ample proof of Mr. Schumann's skill. In training these animals the use of force has been absolutely avoided. This was necessary to attain the object in view, considering the shyness of deer. It was indeed a difficult task to "break in" these noble beasts, so that they could "do a turn" at the circus which would earn for them applause and admiration, and for their master well-deserved praise.

TRAINED DEER LEAPING INTO A TANK OF WATER.

Naturally, comparatively young animals were in this instance selected, for it would have been impossible to train an older animal. The young deer is elevated to a height of about 35 feet above the ring in a specially constructed box having a side door. This done, the door of the box is opened by means of an ingenious mechanism, whereupon the animal, as if gaging the distance to the tank beneath, draws itself together for a leap. At the command of its master, the deer gracefully bounds down into the water below. After swimming to the edge of the tank and climbing into the ring, the animal frolics in the sawdust. The same feats are then performed by a second deer with equal grace.

Whether or no a deer would undertake so perilous a feat in his native forest, even when hard pressed by an enemy, is a question which cannot be definitely answered; for although he will leap over formidable obstacles and cover no small distance in a single bound, it is by no means certain that he will plunge headlong from a height in his effort to escape.

The largest engineering society in the world is the Verein Deutscher Ingenieure; it now has about 15,000 members. It publishes finely illustrated transactions.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

A German View of United States Development.—The German central bureau for the preparation of commercial treaties has just published a book written by its president, Dr. Vosberg-Rekow, who, as a German delegate, attended our last year's Philadelphia industrial exposition and spent months in investigating the industrial conditions in the United States. This book is remarkable for the candor and ability with which Dr. Rekow handles his important theme, "The Commercial Treaties of 1903," in the treatment of which he reviews the economic conditions of the great industrial powers and their relations toward each other as competitors. He devotes much attention to Russia, which he considers not only as a most valuable market for industrial products, but also from the broader base of a future source of supply of raw materials (cotton, petroleum, metals, etc.) instead of the United States, which latter the doctor declares to be the most dangerous opponent to Germany's industrial power and commercial advance. Dr. Rekow says that there are but three great world powers—Great Britain, Russia and the United States. After discussing Germany's position toward the two first named in her struggles for industrial and commercial advancement, he says, regarding the United States:

"I now come to the last, and, as I think, the most powerful rival to our economic future. I mean the United States. It has, as far as its strength and characteristics are concerned, very little in common with any other nation, including the other two world powers. The Union forms a great economic realm, which possesses inherently all organic conditions for economic activity and prosperity, and is sufficiently developed to feed its population plentifully, which latter is ample in numbers and in culture to make its bountiful resources available.

"While Great Britain, with her colonies, likewise possesses all supply sources for human needs, the territories are not generally developed; neither do they form a compact entirety.

"In proof, note the East Indian famine; a condition that could not possibly exist in the United States.

"Viewed from an economical standpoint, Great Britain does not even appear as a unit, for this reason: Divergent trade policies exist in the different parts of the empire, which lack a strong centralized will to give unified action. Russia is, as yet, in an embryo condition. Her mineral resources are awaiting exploitation; those of the United States are already well developed, though far from becoming exhausted. The trans-Caspian cotton cultivation, now in its infancy, is retarded in its efforts to gain a market by the high cost of production and lack of transportation facilities, whereas American cotton is a permanent and potent factor in the world market.

"While the great mass of Russia's population remains in a comatose state and occasionally starves (but a small part of it participating in modern economic work), the entire Yankee nation is like a perfectly disciplined army, standing shoulder to shoulder at the forge, the loom, or the printing press, earning wealth from their industry.

"Rarely, if ever, will there be met, in connection with natural riches like those of the United States, a people like the Americans. No aborigines are fettered by habits inimical to progress. There is a restless tide of immigrants; a population always alert, eager for conquest, without hesitation or scruples. These immigrants are by no means the worst of the population the Old World could spare; on the contrary, some of her cleverest and best children are among them. True, very few have high refinement, but all possess a certain amount of world knowledge, and even the most uncultured of them are endowed with adaptability to cope with life's vicissitudes.

"The influence going out from such a people cannot be otherwise than powerful in a high degree. Scarcely has this immense country been brought under cultivation, but its influence is felt across the oceans. Europe, with her old-established industries, is so hard pushed by the young American competition that the necessity of uniting in a common customs league against the bold intruder has become a matter of serious consideration. Many European lines of manufacture—and by no means the least important—have severely suffered and are still suffering. And while Europe, year after year, takes more goods from the United States, the latter's imports from Europe diminish more and more.

"The United States has covered Europe with a network of consulates, and makes its consuls at the same time inspectors of our exports and vigilant sentinels, who spy out every trade opening or advantage and promptly report it.

"After the Americans had established their supremacy as exporters of agricultural products, which export they have organized in so masterly a manner as to defy all competition, they immediately turned to exportation of industrial products, not of the finest quality, but carefully finished; and, by means of wholesale production, put at so low a price that they will in a very little while conquer the world markets.

"Against this industrial invasion, our customs imposts will avail as little as our grain imposts have done. Very meager chances remain for us; one of these is that we and England retain in our hands the ocean-transportation business, which, to a certain degree, influences imports.

"But the dread struggle will have to be met; the longer it is postponed, the harder it will become for us. Last year we imported from the United States to the value of 907,200,000 marks and exported thereto 377,600,000 marks. It is my opinion that this ratio will not vary much in the future.

"However, these figures denote no danger to us; we import mainly American raw materials, which are indispensable to us, and their increasing volume is the best proof of our industrial advancement. Our chief danger lies in the probable eventuality that America's wholesale production of manufactured articles will drive us out of the foreign markets by underbidding us in price. In short, the Americans are the sole commercial-political opponents whom we must earnestly dread. Russia will remain a profitable customer to us in the future; with Great Britain, we are united by bonds of common interests; the United States is—in an economical sense—our enemy. What must we do in order to keep Russia tributary to us, to maintain the status quo with England, and to successfully fight America?"

Dr. Vosberg-Rekow then at length advocates a close trade union with Russia, expatiating on the great natural riches of that vast empire and Germany's favorable chances of exploiting them. He notes the danger to trade in Russian Asia from the developing Pacific traffic of the United States, and continues:

"The fear of the American industrial invasion should lead us and all European countries to a close union with Russia, which country, with its newly acquired territories in Asia, could reimburse our export trade for the loss of the American and other foreign markets, and, in addition, furnish us with the indispensable raw materials.

"Russian petroleum and trans-Caspian cotton may be made substitutes for the American staples, and, while Russia might not altogether replace the United States as a source of supply for raw product, we should strive to become independent of the Americans and teach them that a change of policy toward us is requisite.

"The United States, reliant on her economic strength, has hitherto maintained an independent—even autonomous—trade policy, altogether according to her own interests, regardless of diplomatic remonstrances and paper protests. A European defensive customs union against the United States has been proposed: but its adoption is not to be thought of at present. But, in renovating its trade treaties, Germany must endeavor to obtain a remedy. Our agrarians attempted to check American assumption by a prohibition against American meat. This action was futile, unpractical and unjust. The meat inspection in the United States is as good as possible. A law prohibiting its importation was not justifiable; it was pharasaical to maintain that sanitary reasons determined this action. It would have been better to have courageously stated the facts.

"When we have once secured our base by means of treaties with Russia and other countries, we can denounce the most-favored nation clause with America, and follow up this step with other measures; but I would distinctly repeat that such action is frivolous unless we have support. I do not believe in a tariff war with the United States. Uncle Sam is not likely to provoke one, because he is too sensible a business man to risk losing such a good customer as we are for his cotton, copper, petroleum, etc.; nor has he a large merchant marine to allow him to dispense with the help of German vessels, which carry his freights to all parts of the world. This is a chance in our favor now, but there can be no doubt that an American merchant marine will ere long be forthcoming and become of vast extent. Whoever has watched the present state of activity in American shipyards will have no doubt on that score. If we now take the right steps, the United States can be induced to conclude a commercial treaty with us that will answer better for our industrial interests than the present one.

"Germany's industrial advancement is principally due to the thoroughness of her technical education. It is strengthened by the continuous substituting of machinery and machine tools for hand labor. Still, in this respect the English industry in some branches is ahead of us. It is worthy of note that in this evolution, too, the United States has the foremost place and has made gigantic strides, not only in applying machine tools, but inventing and manufacturing them; so that to-day she supplies us. This signalizes in an extraordinary degree American intelligence. Thus, the Americans, though wanting our superior technical education, thanks to their practical eye, improve upon our methods and apparatus. Theirs is rather the activity of an experimentalist than that of a trained craftsman; but a clever faiseur, if he but have assurance and luck, may distance the educated master. The Americans have no thorough education; nor do they possess a modern industrial system as we Europeans understand the terms. The American applies himself to a single branch or to a specialty, with utter disregard of European methods and their results; he devotes to his work an amount of energy which stupefies Europeans, and, for a while, he succeeds in driving us out of the line of articles on which he has centered his energy. Against such peculiar activity a general trade policy is quite ineffectual; we must put ourselves in condition to counteract this artificially forced growth of specialized industry."—Simon W. Hanauer, Vice Consul-General at Frankfort.

Electric Lights and Cars in Asuncion.—The Paraguay Development Company, incorporated with $500,000 capital under the laws of the State of New Jersey and having headquarters in Philadelphia, has been granted by the Paraguayan government a concession to light the city of Asuncion and to run tram cars by electric power.

The concession is for twenty-five years, and the light and traction service must be open to the public within two years from date of concession (August 30, 1900).

The representative of the company in Paraguay is Mr. Carlos R. Santos, late delegate to the Philadelphia Museum Exposition.

In my opinion the grant is very valuable, and it is probable that other concessions would be given to reliable concerns.

The country needs transportation facilities to enable it to exploit its natural resources, and I feel confident that the government would grant liberal concessions for railways. Industries are unknown in the country, and the government would welcome and protect the development of almost anything in this line.—W. Harrison, Vice-Consul at Asuncion.

Profits of Russian Spinners.—Consul Marshal Halstead, of Birmingham, under date of September 26, 1900, sends the following extract from a recent number of Sell's Commercial Intelligence:

"In his interesting series of letters entitled 'Round Russia,' now appearing in The Daily Chronicle, Mr. Henry Norman speaks of the wonderful development of the cotton industry. In 1886 there were over two million spindles in the Moscow district, and as many more in other places. From 1880 to 1889 the output of the cotton-manufacturing industry rose from 240,000,000 rubles to 487,000,000 rubles. During the ten years that have since elapsed vast progress has been made, but serious statistics cannot be obtained.

"Lancashire will learn with subdued interest, however, of dividends varying from 20 per cent. as an ordinary return to as much as 80 per cent.

"National jealousy and the fact that Russia has largely learned what she employed them to find out, has led to the disappearance of the English foremen who a few years ago were common in Russian mills.

"One other matter in connection with cotton in Russia calls for attention. Most of the raw material comes from America and Egypt. But in Turkestan Russia has come into possession of a cotton-growing country of great possibilities. Last year a Moscow merchant told Mr. Norman 350,000 bales came from there, and this, it must be remembered, is favored by escaping the heavy duty which foreign cotton has to pay. An official publication contains this statement: 'In the near future, probably the greater part of the Russian cotton industry will be supplied with the native raw material.' But as all the cotton of Turkestan is dependent upon irrigation and water is scarce there, the Moscow spinners do not yet share this optimistic hope."

Export of German Laundry Goods.—Vice Consul-General Hanauer reports from Frankfort, September 6, 1900:

"The exportation of German laundry goods during the first half of this year reached 1,146 metric tons (of 2,204 pounds avoirdupois), valued at 8,943,000 marks ($2,128,434). Of this exportation 26·3 per cent. went to Holland, 23 per cent. to Russia, 7·4 per cent. to Denmark, 9·7 per cent. to Switzerland, 6·3 per cent. to England, 7·4 per cent. to Sweden and Norway, and smaller amounts to Belgium and Australia.

"Our manufacture of shirts, collars, cuffs, etc., has reached a much higher state of perfection in cut and fit, in sewing, quality of goods, and in the starching and ironing process than any goods of foreign make, and the fact that we are not in the front as exporters in this important line of merchandise must again be attributed to our deficiency in mercantile ability and inexperience as salesmen. In Frankfort, men's white shirts made to order (not fine quality) cost from $2 to $3 apiece, and collars from $2.50 to $3 per dozen."

New Dry Docks in Vladivostock.—Consul Smith writes from Moscow, September, 12, 1900, that in March last the Russian government decided to construct new dry docks in Vladivostock, which will be capable of admitting ships of 700 feet in length. The excavations for these docks are now being started. Near the docks will be constructed two large metallic shipbuilding yards capable of turning out ships up to 3,000 tons. The old dock, the "Tsarevitch," is being rebuilt, and six new boilers have been ordered therefor. The work is superintended by Military Engineer Savitzky, with three assistants. The government has also decided to construct and equip sixty new mechanical shops.

Vintage Prospects on the Rhine.—Consul Schumann sends the following from Mainz, September 12, 1900:

Without doubt the vineyards of the Rheingau, that section of the wine-producing country which lies between Lorch and Schierstein on the right bank of the Rhine, and includes such well-known places as Assmannshausen, Lorch, Rüdesheim, Erbach, Geisenheim, Schloss Johannisberg, Rauenthal, etc., produce the finest Rhine wines of the country. This is due in a great measure to the southerly exposure of the vineyards, the vines thus getting the greatest possible amount of sunshine. The present condition of the vineyards of this section is, on the whole, very satisfactory. The vines and foilage are mostly healthy. As to the quality, a good middle wine is expected.

Silk Industry in Europe.—Under date of October 6, 1900, Consul Hughes, of Coburg, says:

Owing to the disturbances in China, this industry is suffering in Germany, Italy, France, and Switzerland. A large falling off in the yield is shown as compared with last year, and it is feared that deliveries may be suspended. The prospect is the more serious as China silk is essentially the material for cheap fabrics. There is a general curtailment of production in the silk mills of the lower Rhine district. From Crefeld it is reported that an important firm of machinists, engaged in the production of machinery and appliances for silk manufacture, is dismissing large numbers of workmen.

American Shoes in France.—Vice Consul-General Hanauer writes from Frankfort, September 6, 1900:

Official statistics show that in the first six months of the present year the value of shoes exported from France was 7,995,780 francs ($1,543,186), against 9,157,590 francs ($1,767,415) last year. The importation of these articles into France is steadily increasing in spite of the high import duty. In the first half year of 1900 there were imported into France 432,500 pairs of shoes; in the first half year of 1899, 304,500 pairs.

The United States is an important factor in this influx movement, American shoes valued at 37,000 francs ($7,141) having been imported into France during the month of May alone. Besides this, says The Shoe Market, a German technical journal, United States shoes are crowding those of French make out of the South American markets.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

New Method of Preserving Meat.—This method may be of importance in case of war for supplying the army, and is as follows, according to Oberarzt Deichsteller, of Munich:

Entire unboweled cattle or large suitably severed pieces are sprinkled with acetic acid and then packed and transported in sawdust impregnated with cooking salt and sterilized.—Deutsche Militär Zeitschrift.

Coating Metallic Surfaces With Glass.—Metallic surfaces may be coated with glass by melting together 125 parts (by weight) of flint-glass fragments, 20 parts of sodium carbonate and 12 parts of boracic acid. The molten mass is next poured on some hard and cold surface, stone or metal, and after it has cooled, it is powdered. Make a mixture of 50° Bé. of this powder and sodium silicate (water glass). The metal to be glazed is coated with this and heated in a muffle or any other oven until the mixture melts and can be evenly distributed. This glass coating adheres firmly to iron and steel.—Die Werkstatt.

Cinchona Pomade and Cantharides Pomade.—

CINCHONA POMADE.

Ox marrow	325 grammes
Lard	225 "
Sweet almond oil	55 "
Peru balsam	3 "
Quinine sulphate	3 "
Clover oil	7 "
Rose essence	30 drops.

CANTHARIDES POMADE.

Ox marrow	900 grammes.
White wax	100 "
Mace oil	3 "
Clove oil	3 "
Rose essence or geranium oil	30 drops.
Tincture of cantharides	28 grammes.

—Neueste Erfindungen und Erfahrungen.

Production of Metallic Coatings Without a Battery.—In order to silver copper, brass, bronze, or coppered metallic articles, dissolve, according to Laugbein, 10 grammes of lunar caustic in 500 grammes of distilled water, and 35 grammes of potassium cyanide (98 per cent.) in 500 grammes of distilled water, mix both solutions with stirring, heat to 80° to 90° C. in an enameled vessel, and enter the articles, well cleansed of fat and impurities, until a uniform coating has formed.

Zinc, brass, and copper are silvered by applying a paste of the following composition: 10 grammes of silver nitrate, dissolved in 50 grammes of distilled water, and 25 grammes of potassium cyanide, dissolved in distilled water; mix, stir, and filter. Moisten 100 grammes of whiting and 400 grammes of powdered tartar with enough of the above solution to cause a paste-like mass to result, which is applied by means of a brush on the well-cleaned objects. After the drying of this coating, rinse off and dry in saw-dust.

To silver brass and copper by friction, rub on the articles, previously cleaned of grease, a paste of silver chloride, 10 grammes; cooking salt, 20 grammes; powdered tartar, 20 grammes; and the necessary water, using a rag.

In order to do silvering by the use of zinc contact, dissolve, according to Buchner, 10 grammes of silver nitrate in water, and precipitate silver chloride by admixture of hydrochloric acid. Wash the latter several times in water, dissolve in 70 grammes of spirit of sal ammoniac, and then add 40 grammes of soda crystals, 40 grammes of pure potassium cyanide and 15 grammes of cooking salt. Now dilute the solution with enough distilled water to make up a total of 1 liter.

Smaller articles of brass are silvered by boiling and by means of zinc contact in a solution which is produced by dissolving 10 grammes of lunar caustic in water and adding 10 grammes of potassium cyanide, 17 grammes of cooking salt, 15 grammes of potassium carbonate, 10 grammes of yellow prussiate of potash and enough water to make up 1 liter of liquid.

Böttger's silvering fluid for iron, steel, copper and brass consists of silver hyposulphite, 2 parts; sal ammoniac, 1 part; and water, 20 parts.

Kayser's silvering liquid, which is excellent for all kinds of metals, is prepared from lunar caustic, 11 parts; sodium hyposulphite, 20 parts; sal ammoniac, 12 parts; whiting, 20 parts; and distilled water, 200 parts. The articles must be cleaned well.

For gilding copper and brass by boiling (iron, steel, tin and zinc must previously be coppered) the following bath is adapted, according to Langbein: Dissolve 1 gramme of gold chloride and 16 grammes of potassium cyanide in 250 grammes of water, and 5 grammes of sodium phosphate and 3 grammes of caustic potash in 750 grammes of water, cold; mix the solutions and heat to a boil. If the action decreases, add another 3 to 5 grammes of potassium cyanide.

Polished iron and steel articles are first coppered by immersion in a solution of blue vitriol, 5 grammes, and sulphuric acid, 2 grammes, in 1 liter of water; then dip them in a hot solution of 6 grammes of gold chloride and 22½ of soda crystals in 75 grammes of water. The coating of gold may be polished.

Gilding by means of zinc contact may be done in the following solution: Gold chloride, 2 grammes; potassium cyanide, 5 grammes; sodium sulphite, 10 grammes; and sodium phosphate, 60 grammes, dissolved in 1 liter. Use the bath hot.

A gilding liquor to be used cold without potassium cyanide consists of gold chloride, 7 grammes; yellow prussiate of potash, 30 grammes; potash, 30 grammes; cooking salt, 30 grammes; and water, 1 liter.

To gild zinc articles, dissolve 20 grammes of gold chloride in 20 grammes of distilled water, and 80 grammes of potassium cyanide in 80 grammes of water, mix the solutions, stir a few times, filter and add tartar, 5 grammes, and fine chalk, 100 grammes. The resulting paste is applied with a brush. Objects of copper and brass are previously coated with zinc.

This is done in the following manner: Heat a concentrated sal ammoniac solution to a boil with addition of zinc-dust and enter the thoroughly cleaned objects until a uniform zinc coating has formed.

Or else boil the articles in a concentrated caustic soda solution with zinc-dust.

Antimonizing of brass, copper, iron and silver.—Especially brass articles attain a very handsome steel-gray coloring, owing to a thin coating of metallic antimony, by immersion in antimony chloride solution.—Journal der Goldschmiedekunst.

PAN-AMERICAN EXPOSITION NOTES.

Within the Exposition grounds are 133 acres of Delaware Park, including the Park Lake. This lake is a very beautiful body of water, and upon its shores the United States government will erect a life-saving station, where a crew of ten men will give daily exhibitions during the Exposition season, showing the uses of life-saving apparatus.

Music is to be one of the attractions of the Exposition. Contracts have been made for a series of concerts by Sousa's Band, and the Mexican Government Mounted Band of sixty-two men. Many other famous organizations will be engaged. Large music gardens have been planned, and band stands will be erected at various points. The Temple of Music is one of the most beautiful of the Exposition buildings, having an auditorium with a seating capacity of 2,200, and containing one of the largest and finest pipe organs ever built in the United States.

The advance of knowledge upon the subject of irrigation has prompted the management of the Pan-American Exposition to provide for an adequate exhibit showing methods of irrigation and various tools and supplies for use by the practical irrigator. Water for irrigation is now being drawn from deep wells and groups of wells by means of wind engines as well as by engines of higher efficiency. The established practicability of this means of securing water has opened a new field for manufacturers of engines and pumping machinery, and their utility and economy will be demonstrated at the Exhibition.

The United States government is spending $500,000 upon its group of three great buildings and the exhibits to be contained in them. The several departments of the government will make very complete displays, and in addition to these will be new exhibits from the Hawaiian and Philippine Islands, Tutuila, Guam, Porto Rico and Cuba. Among the more important features will be the great exhibit of fishes, the Weather Bureau, exhibits from the Mint, naval and war exhibits and many others. Of particular interest will be the big gun exhibit—a group of three immense pieces of ordnance being mounted immediately at the north of the main government building.

A display of interest to every progressive farmer at the Pan-American Exposition will be the variety and methods of farm fencing. Barring the old stump fencing of pioneer days and the stone walls of New England, a great variety of fences will be shown. The cleanliness, cheapness, efficiency and durability of the wire fence have been so well demonstrated by practical use that the metallic fence will undoubtedly have first claim upon popular attention; but when it comes to say which metallic fence is the best, a question for a many-sided discussion is opened up. However, the Pan-American Exposition exhibits will help every farmer toward a solution of the problem on his own lines.

The Ethnology building, although smaller than the buildings devoted to Agriculture, Machinery, Manufactures, etc., is one of the most beautiful of the Pan-American group. It is circular in general outline, with a diameter of 128 feet. The arrangement of pillars within divides it into eight equal parts, and there are two broad balconies, the whole being lighted from a large dome.

The ground floor of the building will be devoted to specially prepared exhibits by the Exposition Company, by Mexico and Central and South American republics, by the American Museum of Natural History of New York city, and various State museums. In the center of the floor will be a large model of the Niagara Frontier, with running water. On this model will be located the various sites of Indian occupancy of the region.

The first balcony will be devoted to the exhibition of collections of Indian relics in cases. A few cases will be devoted to the illustration of the transition period, when the Indians retained their primitive customs of life, but used large numbers of European implements obtained in trade. The first balcony will also contain a number of manuscript books and letters of the early explorers and missionaries, and manuscript dictionaries, grammars, etc., explaining some of the Indian languages now almost extinct. Very little attention will be paid to modern Indians in the building, but on the grounds there will be some sixty members of the Six Confederate Iroquois tribes living in bark houses and engaged in such industries as basket making, bead work, canoe building, etc., in which arts the Indians have always shown special skill. At some distance from the Ethnology building will be a collection of mounds reproduced from the choicest specimens of the mound builders' industry. In the center of the group of mounds will be a reproduction of one of the round tumuli of Ohio, with a burial chamber open to the public. From the top of this mound the visitor can look down upon the mastodon mound, which is of particular interest as showing that man was coincident with this extinct animal of America. The mound representing a serpent swallowing an egg and a stone outline of a buffalo in South Dakota and several other earth and stone effigies will be reproduced.

The Pan-American Exposition will be held in the city of Buffalo during the season of 1901. The gates will open on May 1, and the Exposition will continue six months. It is estimated that the total cost of the Exposition, exclusive of exhibits but including the Midway, will be about $10,000,000. It is intended that this Exposition shall be the most artistic creation ever produced for a like purpose. It will surpass all former enterprises of this sort in a number of very important features. These are: First, the court settings, there being more than thirty-three acres of beautiful courts. This is approximately two and a half times greater than the area of the courts at the World's Columbian Exposition at Chicago. The second point of superiority is in the hydraulic and fountain effects, there being in all the courts large pools of water into which hundreds of fountains will throw their sparkling streams. As a third feature may be mentioned the horticultural and garden effects. In all the courts and upon the grounds outside the buildings will be a very elaborate decorative arrangement of beautiful lawns and gardens. As a fourth feature may be noted the plastic ornamentation of the buildings, which is very intricate and beautiful. All the buildings are to be covered with staff, which is moulded into thousands of beautiful and fanciful shapes. To this feature will be added the most magnificent display of original sculpture ever used for decorative purposes at any exposition. These wonderful productions are the work of thirty or more of the most noted sculptors of America. There will be more than 125 grand works of this character. As a fifth feature will be the color decorations. Never before at any exposition has an effort been made to produce a harmonious color scheme. All of the great buildings will be decorated in harmonious tints, and the effect upon the eye will be very beautiful. Crowning the achievements of the architects and artists, the sculptors, the landscape architects and the hydraulic engineer will be the work of the electrician. It is he who will complete the magnificent picture when at night he imparts the exquisite radiance of wonderful electric lighting effects to the marvelous picture. More than 300,000 electric lamps will be used in the illumination of the courts of the Pan-American Exposition. Never before has such a work been undertaken upon so grand a scale.

In all the exhibit divisions the Pan-American Exposition will be very complete. It is the aim of the Exposition to show the progress of the Nineteenth Century in the Western world. The exhibits will be gathered from all the principal states and countries of the Western Hemisphere and the new island possessions of the United States government. Special efforts are being made to bring together exhibits of exceptional novelty and of the highest educational value.

Farmers who are wide awake to the possibilities of their calling follow closely the improvements of farm machinery and are more or less familiar with all that is new in the market. Moreover, the agents of the manufacturers are generally so active that even the most indifferent cannot remain long in ignorance of what is going on in the world of farm machinery. The improvements of recent years and the new machines that have been put upon the markets are more numerous than ever. The inventor has been the farmer's steadfast friend and has produced a machine of light, strong, durable construction for saving labor, it would seem, in almost every possible way. But still the advance goes on, and surprises come with astonishing frequency. The exhibits of farm machinery at the Pan-American Exposition in Buffalo next year will be a revelation even to those who consider themselves up to date in their knowledge of this line of progress. The wonderful production of steel and decline in prices, the improvements of machine tools, and the more thorough systematizing of work in factories have had a marked effect upon the prices of farm machines of all kinds. The modern farmer is helpless without a fairly complete equipment of machinery, and the difficulty in obtaining satisfactory farm help has been a great stimulus to the adaptation of machinery to the multitude of tasks upon the farm. How completely these demands have been met by inventors and manufacturers will be well illustrated at the Pan-American Exposition.

The manufacturers throughout the United States are showing a lively interest in the farm machinery displays, which will be sheltered in a special building at the Exposition. The division is under the supervision of Thomas M. Moore, who is well known in the machinery and implement trade. The exhibits will embrace a great variety of new and effective machines, ranging from the immense harvesters and thrashers used only upon the Pacific coast to the small and simple machines employed by the farmers in New England. The wide range of selection now offered to the American farmer has had much to do with the progress that is to be noted in the industry of farming. It is impossible here to specify the great variety of farm machines and implements that will be on exhibition at Buffalo next year, but a few lines may be mentioned. For example, there will be a great variety of traction engines, portable engines, and the small gas, gasoline, oil, and steam engines of simple construction, specially built for small power purposes upon the farm and made to be sold at a low price. There will be a special collection of windmills, one of the most ancient machines for developing power employed by the farmer. There has been, however, a surprising development in the efficiency and value of wind power machines. The exhibits will include types of old Dutch windmills of Holland and the big strong wind engines of the present day. The displays of road machinery will be of especial interest in these days of the good roads movement. To these will be added machinery for the construction of cycle paths, which promise eventually to be quite as numerous as the highways. The bicycle has long since passed the stage when it was regarded as a plaything or a vehicle for pleasure, and has become useful not alone to the city dweller but to the farmer as a means of getting about both upon the country roads and upon the farm. The machines especially designed for road and cycle path construction have been the means of greatly cheapening the cost of producing excellent highways, and a knowledge of these machines should be a part of every farmer's education. These exhibits will include graders, ditchers, rollers, stone crushers, excavating and carrying machinery, and contractors' supplies in general. Along with these will be exhibits of roads and streets in various stages of construction. These will illustrate the selection of materials so as to form an object lesson to those who desire to acquire a practical knowledge of road making and to learn the uses and advantages of different road machines. In the exhibits of farm machinery will of course be included all sorts of new plows, cultivators, wheel-hoes, and other tools demanded by the up-to-date truck gardener; potato planters and diggers, corn planters, cultivators and harvesters, silos and ensilage machinery, mowers, thrashers and grain-cleaning machinery, and a thousand and one other things of utility intended for use upon the farm. The Pan-American Exposition will give to every one interested in the development of farm machinery an opportunity to study the latest types of machines of every kind. It should attract everyone who is associated in any way with their manufacture or use.

A NEW COMPOUND LOCOMOTIVE.

By John Riekie.

The object of this paper is to describe and bring to notice an improved system of using steam expansively, and which is applicable to all engines, being especially suitable to locomotive, electric light, and other engines which have to deal with variable loads, with economy both in wear and tear to machinery as well as in steam consumption, at the same time having a reserve of power.

In its application to locomotives it has been tried on two engines on the Indian State Railways with gratifying results.

The system consists in retaining the two high-pressure cylinders of a simple engine and adding a third or low-pressure cylinder, all acting on cranks at or coupled to 120 degrees. The ratio of the combined area of the two high-pressure is to the low-pressure cylinders as 1 : 1·25, and here the great difference between this system and all previous arrangements steps in, viz., on cutting off steam early in two high-pressure cylinders in place of late in one large or two smaller high-pressure cylinders, also in adopting a new departure in cylinder ratio to suit this early cut-off. The object for so doing will be explained presently.

With regard to the locomotives working in India, engine No. 566, the first of the two built, was a four-wheel coupled, with drivers 6 feet in diameter, but on a small scale, and was run on a service with light loads. The high-pressure cylinders were coupled to the trailing-wheels, the low-pressure cylinder being coupled to the driving axle with side rods coupling the crank pins at angles of 120 degrees. Later on two 16-inch high-pressure and one 26-inch low-pressure cylinders were fitted to this engine, all coupled to one crank axle with a stroke of 24 inches.

The second engine was an inside two-cylinder compound, No. 20, illustrated, having six wheels coupled, 61 inches in diameter, and was converted to this system and is at present at work on the East Coast Railway. This engine originally had one 20-inch high-pressure and one 28-inch low-pressure cylinders, with a stroke of 26 inches. The 28-inch cylinder of this engine was retained, allowing the crank of the high-pressure cylinder to run idle. Two 18-inch high-pressure cylinders were fitted on outside the frames and connected to the coupling-rod pins, the stroke of which was increased from 22 inches to 24 inches. It may be here pointed out that balance weights were attached to the idle crank, as also to the low-pressure crank; indeed, the wheels were also balanced, so that all revolving parts were balanced in a vertical plane. Piston valves are used on top of the high-pressure cylinders, and are actuated by the ordinary Stephenson link motion, with which the engine was originally fitted, with the addition of a rocking shaft.

The low-pressure valve is driven by a loose sheave, with a specially designed arrangement to enable the steam ports to be early and fully opened at all speeds, the cut-off remaining constant at 80 per cent. of the stroke of the piston. The composition of the train was ten coaching and thirty fully loaded goods vehicles, or forty vehicles in all, aggregating 737 tons, exclusive of engine and tender, the weight of which is 92 tons. A pressure of 15 pounds in the receiver is at all times ample to run this train to time on the level.

The author would now like to explain why he has adopted two large high-pressure cylinders in place of one large or two smaller ones, as also a ratio of about one-half that in use, and which is absolutely at variance with all previous practice and orthodox ideas on this subject. Nevertheless, the author claims from these innovations that not only is a wider range of expansion obtained, as also more work got out of a given volume of steam, but that there is a greater reserve of power with this system than can be obtained by any other. Regarding the early cut-off advocated by the author, it is well known that economy in steam consumption was first forcibly brought to light when an early cut-off was first introduced in high-pressure cylinders; it therefore appears obvious that this early cut-off should be retained with existing cylinder ratios. It is not practicable to retain this advantage when compounding an engine with one large or two smaller high-pressure cylinders, on account of the rise and fall in steam pressure, and that would take place in the receiver, to say nothing of the unequal work that would be done in each cylinder. The author, therefore, advocates dividing up a given volume of steam, and using the same in two cylinders, with an early cut-off in each, adopting a new ratio to suit, and so feeding a supply of steam to the receiver at a constant pressure. This arrangement gives a larger cylinder capacity over which the steam is used than can be had by any system yet tried. The two exhausts from the high-pressure cylinders taking place during the one forward or backward stroke of the low-pressure piston enables this to be accomplished, obviously getting more work out of the steam. It must also be clear that if an engine is designed to exert great power with two large cylinders having an early cut-off, it can be relied on to exert a much greater power than if it had been designed with one large cylinder or two smaller ones with a late cut-off, to exert the same power as the engine does with the early cut-off.

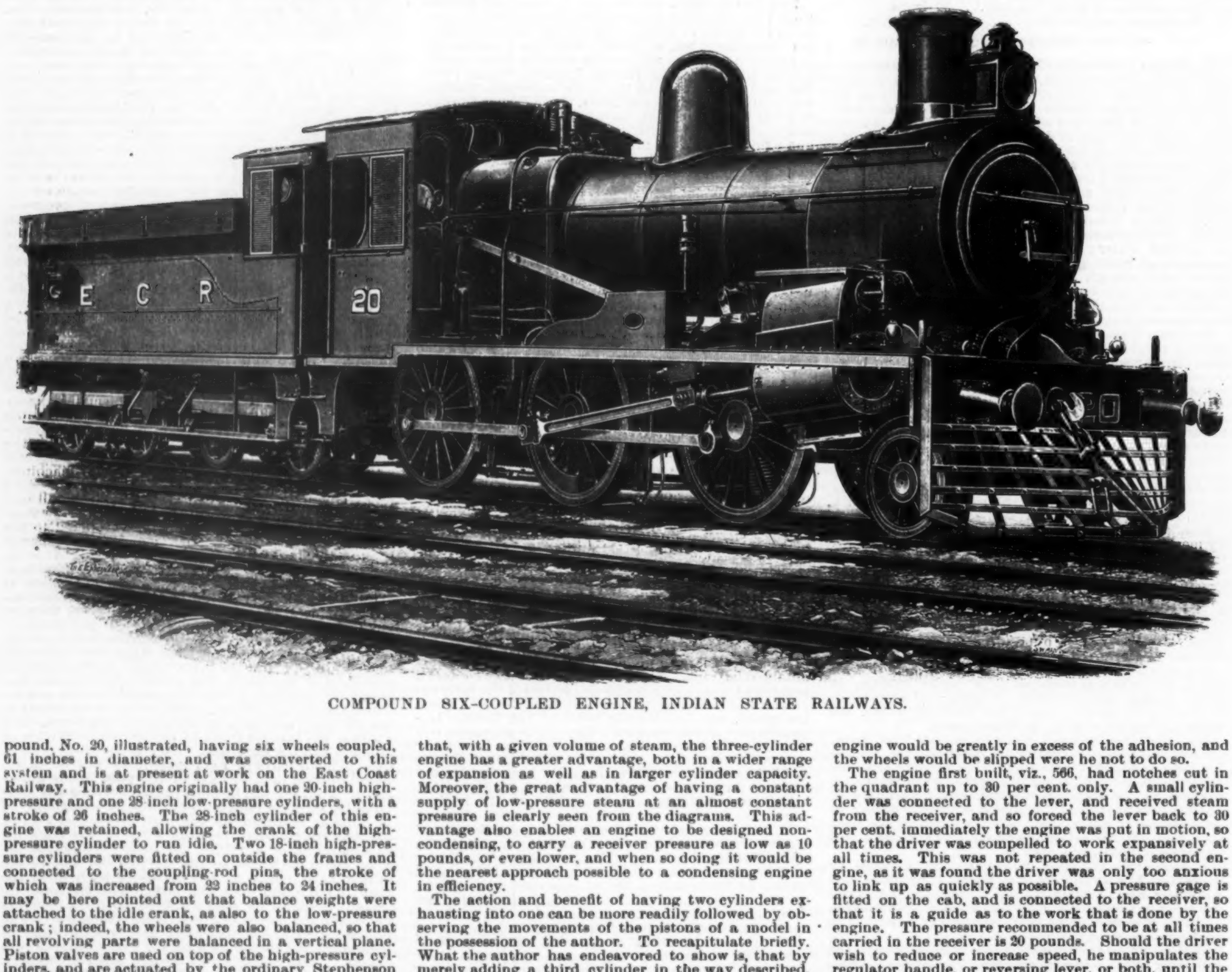
When the low-pressure piston is commencing a stroke, the front of the one high-pressure cylinder is exhausting into the receiver. After the piston has traveled some distance, exhaust takes place from the other cylinder, and so an almost constant pressure, as low as may be desired, is kept up in the receiver, minimizing receiver drop. It will therefore be evident that, with a given volume of steam, the three-cylinder engine has a greater advantage, both in a wider range of expansion as well as in larger cylinder capacity. Moreover, the great advantage of having a constant supply of low-pressure steam at an almost constant pressure is clearly seen from the diagrams. This advantage also enables an engine to be designed non-condensing, to carry a receiver pressure as low as 10 pounds, or even lower, and when so doing it would be the nearest approach possible to a condensing engine in efficiency.

The action and benefit of having two cylinders exhausting into one can be more readily followed by observing the movements of the pistons of a model in the possession of the author. To recapitulate briefly. What the author has endeavored to show is, that by merely adding a third cylinder in the way described, using his proposed ratio, to any existing simple engine, not only is economy enhanced by using an early cut-off in the high-pressure cylinders, but a wider range of expansion can be had from a given volume of steam. Moreover, when boiler pressure is increased, it compensates for the loss due to back pressure, restoring the original M.E.P. in the high-pressure cylinders of a simple engine. As the low-pressure cylinder does a duty equal to one high-pressure cylinder, the result is a 30 per cent. increase in power more than the simple engine. The benefit of this system is still more forcibly brought to notice when applied to a locomotive on English railways, for with the restriction due to gage, it is practicable by adopting the system to put in cylinders having a capacity 60 per cent. larger than the largest that can be got in with existing practice.

The use of large cylinders brings in the question of boiler power, but here the author would point out that his system does not require larger boiler power, for he does not propose using more steam than is now done; what he does propose to do is to use the same weight of steam over larger piston surfaces, with a lower final exhaust pressure. A high boiler pressure is at all times recommended. The boiler pressure in use on goods engine No. 20 is 180 pounds; more than 140 pounds, however, is never required in the high-pressure steam chest on the level. Wire-drawing the steam from the boiler to the steam chest is considered an advantage, as it results in dry steam being delivered to the cylinders. The great power of an engine built on this system, having an early cut-off, and with a reserve of boiler pressure, is self-evident, and places in the hands of the driver such a reserve of power that an assisting pilot is never required unless a load is tacked on beyond the limits of adhesion of the engine.

The power of this type of engine will be better understood when it is made known that no difficulty is experienced in starting trains of 800 tons weight. Moreover, the goods stock in India are all fitted with screw couplings and tightly coupled up. With such large cylinder capacity there is no reason why wheels with large diameter should not be retained, and so reduce piston speed when running fast trains. Indeed, for level line working it is practicable to have one type of engine for all trains, and a six-wheel coupled engine, with wheels 7 feet or even 8 feet diameter, is recommended.

The author will now say a few words with reference to the way the engines are handled by the drivers. It is needless to point out that a starting valve is not required with this system. When the engine is put in motion and the receiver is charged with steam, the driver at once links up the high-pressure lever, no matter what the load may be; indeed, he is forced to do so to prevent the safety valve fixed to the low-pressure receiver blowing off—this valve is set to blow off at 80 pounds pressure; moreover, the power of the engine would be greatly in excess of the adhesion, and the wheels would be slipped were he not to do so.



COMPOUND SIX-COUPLED ENGINE, INDIAN STATE RAILWAYS.

The engine first built, viz., 566, had notches cut in the quadrant up to 30 per cent. only. A small cylinder was connected to the lever, and received steam from the receiver, and so forced the lever back to 30 per cent. immediately the engine was put in motion, so that the driver was compelled to work expansively at all times. This was not repeated in the second engine, as it was found the driver was only too anxious to link up as quickly as possible. A pressure gage is fitted on the cab, and is connected to the receiver, so that it is a guide as to the work that is done by the engine. The pressure recommended to be at all times carried in the receiver is 20 pounds. Should the driver wish to reduce or increase speed, he manipulates the regulator handle, or reversing lever, or both, until the pressure falls below 20 pounds. If, on the other hand, he wishes to increase speed, he opens the regulator or puts the lever forward until the pressure rises above 20 pounds. There is absolutely no guesswork whatever; the nicety with which the engine responds to the fall and rise in pressure requires to be seen to be realized.

The drivers are charmed with the ease with which the work is done, and can scarcely conceive they are not working a simple engine; indeed, they treat and handle it in every way similar to a simple one.

In addition to the great power and economy in steam consumption that is brought about by the adoption of this system, there is still one more, and, in the opinion of the author, a most important one, which is the remarkable reduction in wear and tear to boiler and machinery that may be expected from an engine when working on heavy grades; for it is when so working that the excessive wear and tear to these are prominently brought to notice, the former due to heavy blast, and the latter to the cranks being placed

at 90 degrees. The heavy blast is a necessity, so that the boiler can be forced to generate steam to make up for what is now wasted up the chimney and causes the tubes to leak; the constant use of the tube expander so stretches the tube plate that it is soon ruined, not only causing great loss in having to renew the tube plate, but in laying the engine up while repairs are being done to the boiler. The early cut-off advocated retains steam in the boiler, so that a heavy blast is not a necessity, as at present; moreover, the soft blast not only greatly enhances the life of the tube plate, but dispenses with the necessity for a spark arrester. The wear and tear due to 90-degree cranks is so deplorable that only those who have had to attend to the repairs of engines that have had to exert a maximum power can have any conception as to the real state of affairs; the great damage referred to is that known as pounding. Unfortunately, the greater the power applied to two cranks, the more frequently has the engine to be laid up for repairs, which is due to the two cranks being alternately at work above and below the axle; even on level-line working, the wear and tear is becoming excessive, now that goods engines are being designed to exert great power. In engines worked by the author, this wear takes place after running 25,000 miles, the engine then having to be thrown out of work until the whole of the six tires are turned up, reducing the diameter of the wheel by 1½ inches. The engine referred to is the ordinary six-wheeled coupled, which is becoming so universal, and has cylinders 18 inches by 26 inches, and six wheels 54 inches in diameter. The introduction of three cranks to a locomotive having the three cranks on one axle at 120 degrees apart gives a better turning effort, and reduces wear considerably, and is offered as a solution of the trouble. The introduction of the four-crank engine is on this account strongly commendable; unfortunately, it cannot survive long, for it is not practicable to fit in cylinders that will allow of economy in steam consumption, and still have a cylinder capacity large enough successfully to deal with the ever-increasing loads of trains.

In conclusion, the author would like to point out that the system is applicable to all designs of engines, and is as suitable to the smallest steam motor as it is to the largest stationary or marine engine, and places any one type of engine on an equality with another.

For our engraving and the foregoing particulars, we are indebted to The Engineer.

SOME PRINTING MACHINES AT THE PARIS EXHIBITION.

PRINTING machinery and printing processes are exhibited at Paris under Class II., the first of the third group, which relates to Literature, Science, and the Liberal Arts, and to the means employed for their practical applications. The group includes eight classes, that may be summarized as follows: Printing and printing machinery, photography, books and newspapers, scientific instruments, surgical instruments, musical instruments, the mechanics of the theater. Of these, printing machinery is of the chief interest to our readers, though, as we shall find later on, the collections of scientific instruments will claim much attention from us. The exhibits relating to typography are, as might have been expected, of the highest importance, though the space that could be spared for them was far too limited. It is located on the ground floor in the Liberal Arts building on the Champ de Mars, adjoining the Avenue de Suffren. Unfortunately, until quite a late date no printing machinery could be put in operation. In the French and German courts the machines shown at the beginning of June only emerged from their packing cases and were not in running order; Germany, which was the most advanced at that date, was only making very leisurely efforts to be ready. British participation may be dismissed in a very few words, as regards printing machines; it is represented by a Bremner press, sent incidentally by the proprietors of The Graphic; and by the "Printing Arts Company," who show a very ingenious Russian multicolor machine—the Orloff—which has been described in our columns, and which has no claim to be regarded as an English exhibit. But although the very important exhibits of France and Germany were in a backward state so long after the opening of the Exhibition, a profitable visit could be paid, even then, to the court of the latter country, which contains some very important printing machinery, which well illustrates the position held by Germany in the printing industry.

On a smaller scale than the larger presses is the exhibit of Messrs. Rockstroh and Schneider, manufacturers of printing machinery at Dresden. It forms an interesting contrast to the high-speed rotary Augsburg press, with its capability for enormous output, for the exhibit consists entirely of flat presses, working at a limited speed, but producing very high class work. They are especially adapted for printing facsimile water color work in from four to six colors, and for the production of copies of oil paintings in which the finish of the execution, dependent, of course, on the perfection of the blocks, would have been thought impossible a few years ago. Two of these presses are illustrated in Figs. 2 and 3; they possess several special features which may be noted. The main shaft rests in bearings made in two pieces instead of in bearings recessed in the frame; the guide stops are arranged so as to secure perfect register; and in all respects the press is well made and well designed for excellence and convenience in working. This machine, which, as we have said, is well adapted for the highest class of color work, can also be used for relief printing, a class of work forming a special trade or a branch of the bookbinder's art, but which can easily and profitably be executed by the printer. In Fig. 1 is shown a modification of the same type, intended to produce relief work with heated moulds. The machine is adapted for electrical driving, and a special feature is the great strength introduced, so that the pressure of 80 tons can be used in regular working. Either the matrix or the die, or both, can be heated by steam or gas, according to convenience; the connections conveying the heat to the die are very simple and easily managed. When employed for ordinary surface printing, a double inking table is provided, and the machine is worked either by hand or foot, although if the highest output is desired, it can be driven by power. A special feature may be noted as belonging to this press. It has a reversible inking device, used when two different colored inks are employed at the same time—that is, when each half of the forme is inked by a different color. In producing shaded effects, this device cannot be employed, because it would mix the different colored inks, but an attachment is provided consisting of a special inker on which are a series of inking surfaces, whose positions can be shifted by means of adjusting screws, so that a great variety in color effects can be obtained. A special feature in the inking mechanism of this machine is that the

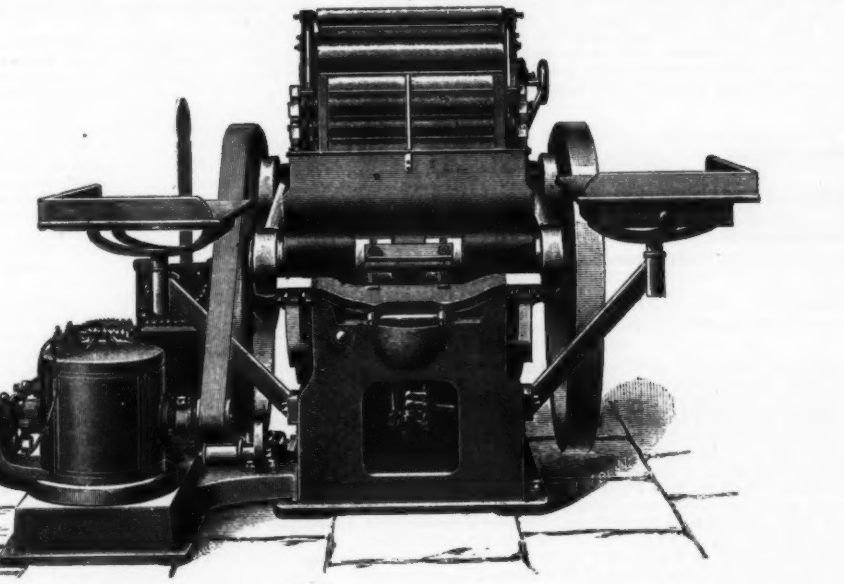


FIG. 1.

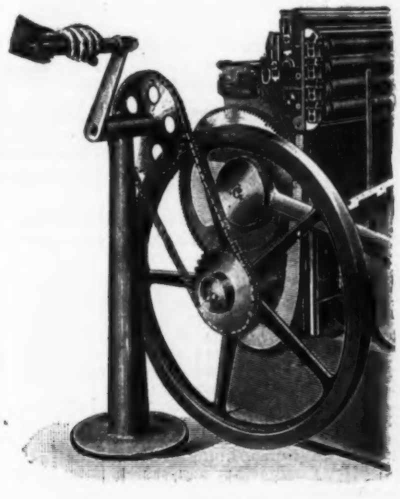


FIG. 4.

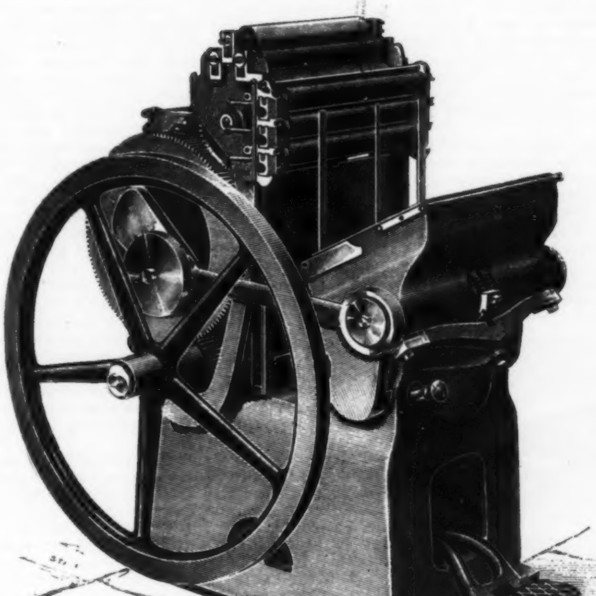


FIG. 2.

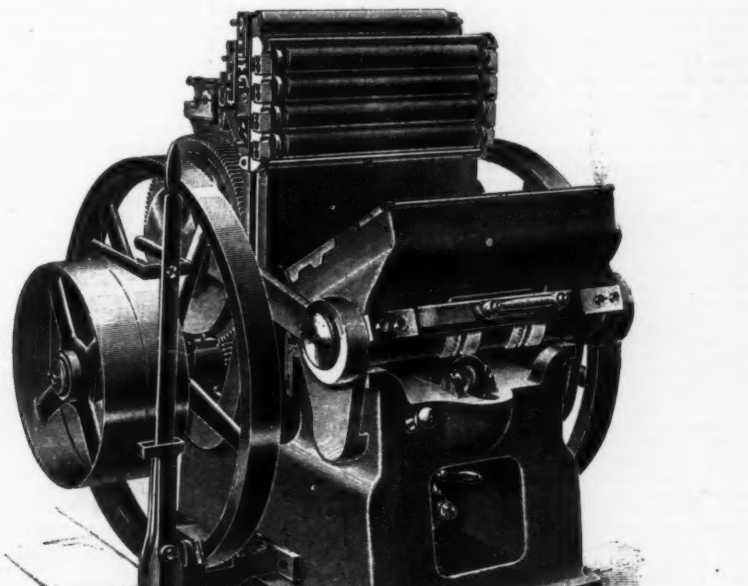


FIG. 3.

PRINTING MACHINERY AT THE PARIS EXHIBITION.

pressure-regulating screws for the feed act on the blade at the back, and not below it; a very sensitive distribution is obtained in this manner. Fig. 4 shows the way in which these presses can be driven by power. The printing machines exhibited by Messrs. Rockstroh and Schneider are furnished with a brake connected with the throwing-out gear; this brake acts, not only against the periphery of the flywheel, but on each side of the run also, thus securing considerable energy in action while reducing the wear on the bearings. The same exhibitors show also a flat press for printing in colors at the rate of 1,500 copies an hour. The general characteristics of all the principal printing machinery shown at Paris, apart from special devices, are excellence of workmanship, high speeds, and great strength of parts, this last having become a necessity, on account of the very high pressures that are required to transfer on paper all the qualities possessed by the half-tone blocks now used almost exclusively both for black and color work. For our engravings and the foregoing particulars we are indebted to Engineering.

A COLLAPSIBLE CENTERING FOR THE CONSTRUCTION OF ARCHED CONDUITS.

THE construction of small masonry tunnels in large modern cities, for sewer systems especially, and for the passage of telephone, telegraph, and pneumatic lines, has assumed an enormous development. For covering them, the vault form is generally adopted, and in most cases with an ovoid or circular section, because such vaults offer a great resistance and perfectly support the loads to which they are submitted. But the construction of a vault, even of quite small dimensions, necessitates the use of centerings that must be mounted with more or less timbering, so that the centering is afterward relatively complicated.

Mr. H. J. Roberts, an English engineer, has just invented a movable, collapsible, and expansible centering (if words so odd can be employed), which permits, so to speak, of an instantaneous mounting and just as rapid a removal of the centering, and which is as ingenious as it is practical.

We give a general view of the apparatus as it appears after removal from a vault that has just been constructed by means of it, and also longitudinal and transverse sections of it. It consists of a sort of elongated car carrying a curved roof embracing more than a semicircumference. This car having been placed upon the invert in the first half of a conduit constructed in the open air, the masonry of the vault is laid upon the roof. After the cement has set, the roof is retracted and folded upon itself. Through the middle of this centering, of which the length is about twelve feet, runs a shaft that is provided at one of its extremities with left hand screw threads and, at the other, with right hand ones. Upon each thread is screwed a nut upon which are assembled four arms through the intermedium of a pivot. In reality, there is no pivot properly so called except for the two vertical arms, the horizontal ones to the right and left being assembled by means of a ball and socket joint in the nut, as shown in the vertical section of the apparatus. These latter arms are connected by a ball and socket joint with the iron plates forming the centering. The necessity of this difference in the assembling is due to the fact that the lateral arms, under the influence of the displacement of the nut along the screw threads, have a forward motion as well as a downward one. The vertical arms are jointed to two U-irons, one of which has its bearing point upon the invert of the conduit, while the other serves, so to speak, as hinges to the iron plates that form the exterior of the centering. These plates are curved according to the circle that forms the template of the conduit, and are stiffened and sustained by angle irons arranged longitudinally as well as circularly.

We have said that the centering under consideration is mounted upon a car. In fact, upon the longitudinal shaft already mentioned are fixed two masses of cast iron, each provided with two large wheels that are so arranged as to rest upon the masonry of the invert according to the radius of the circle that forms the template of the conduit. These masses, or little cars, so to speak, are provided with two recesses into which enters one of the U-irons.

After the invert of a conduit has been finished according to the semi-profile desired, the Roberts centering is placed upon it, and then the hand wheels of the longitudinal shaft are acted upon. The nuts are displaced and the arms act with a tendency toward taking a position at right angles with the shaft, and this causes the U-iron to come into contact with the masonry of the invert and lift the wheels of the cars. This causes the iron plates of the centering to oscillate until they assume the exact form desired. It is then possible to construct the vault. After this, all that has to be done is to revolve the hand wheels in an opposite direction and shove the apparatus further along. All the operations are effected with extraordinary rapidity.

For the above particulars and the illustrations, we are indebted to La Nature.

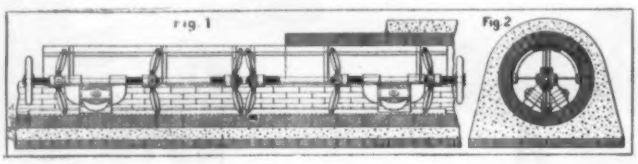


FIG. 1.—LONGITUDINAL SECTION OF THE ROBERTS CENTERING. FIG. 2.—TRANSVERSE SECTION.

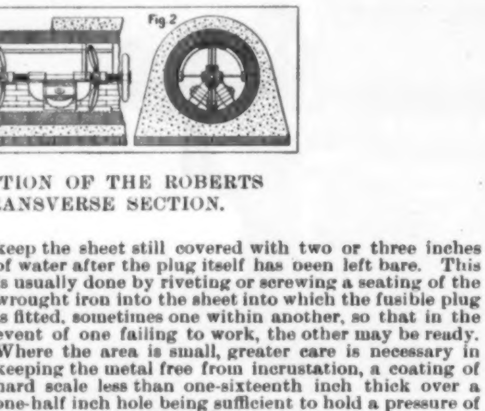


FIG. 3.—THE ROBERTS CENTERING IN PLACE IN, AND REMOVED FROM, A CONDUIT.

FUSIBLE PLUGS.

FUSIBLE plugs are very important adjuncts to a boiler, yet, like everything else about a boiler, they need a great deal of attention, and often more than they get. These plugs usually consist of a piece of tin, lead, and bismuth inserted in various manners in the crown sheet or heads of the boiler, and as will readily be understood, the design being when the water gets too low the fusible metal will be melted by the heat, allowing the water to escape into the fire, or the pressure to be relieved from the boiler. So long as the alloy is kept at a comparatively low temperature by the water on one side, it is of course prevented from melting by the fire on the other.

Notwithstanding the great favor in which they are held, Wilson claims there is no doubt that their efficiency has been much overrated, as in his experience as a boiler inspector numerous cases of failure to work are recorded every year. This is partly due to an accumulation of soot and dirt that usually takes place in the cavity over which the plug is inserted, and partially in consequence of the alteration which takes place in the nature of the alloy during long exposure to the heat of the furnace.

There are numerous instances given by Wilson, also, of fusible metal melting out without liberating the steam pressure. This is chiefly caused by the accumulation of incrustation on the metal being sufficiently strong to withstand the pressure upon it, and prevent the liberation of the steam, and it does not take much to do this. The simple plan of screwing or riveting a piece of lead or fusible metal into a hole should never be adopted, on account of the leakage that often takes place when the plug is slack, which leads to the corrosion, patching, and destruction of the plate. Moreover, the plug will probably not melt until the crown sheet shall have actually become bare. For this reason alone there should be a provision on the furnace plate for the insertion of the plug to keep the sheet still covered with two or three inches of water after the plug itself has been left bare. This is usually done by riveting or screwing a seating of the wrought iron into the sheet into which the fusible plug is fitted, sometimes one within another, so that in the event of one failing to work, the other may be ready. Where the area is small, greater care is necessary in keeping the metal free from incrustation, a coating of hard scale less than one-sixteenth inch thick over a one-half inch hole being sufficient to hold a pressure of 70 to 80 pounds. The mouth of the seating, when that method is used, is made two or three inches in diameter, to allow the easy removal of the soot and greater exposure to the heat.

In making a selection of the description of plug, the nature of the feed water should be considered. With feed water containing much carbonate of lime or magnesia, especially where grease is present, many of the fusible plugs in use are found to be too sensitive, and cause much trouble by melting, even where there is still abundance of water over the sheet, from the same cause as brought about the bulged plates referred to recently.

It must not be supposed that the steam in an ordinary large sized boiler can always be liberated with sufficient rapidity through a small hole to prevent overpressure. Many engineers state that, on the melting of the plug, the discharge of dry steam over the fire greatly increases the heat of combustion. That this will take place under certain favorable conditions there can be no doubt, and is probably one reason why fusible plugs are sometimes ineffective; but when the discharge of water or wet steam over the fire is to any extent, combustion will be retarded, the pressure relieved, and warning of danger given.

To guard against the risk arising from the tendency to change in the nature of the alloy, it is advisable to renew the fusible metal every three or four months, and only plugs that will admit of this should be chosen. Low temperatures can be determined by the melting points of compositions of lead, tin, and bismuth, and the following alloys are given by Welsbach as suitable for fusible plugs, together with their melting points. The second is what is known as Rose's metal, and very commonly used.

Lead.	Tin.	Bismuth.	
1 part.	1 part.	4 parts.	201° Fah.
5 "	3 "	8 "	202° "
2 "	3 "	5 "	202° "
1 "	4 "	5 "	246° "
1 "	— "	1 "	257° "
1 "	1 "	— "	466° "
— "	2 "	1 "	334° "
1 "	3 "	— "	334° "
— "	3 "	1 "	392° "

HOW CRUCIBLES ARE MADE.

By H. C. HOVEY.

THE manufacture of fireproof pottery in the United States is a comparatively limited business. There are large regions, possibly entire States, where not a single crucible is used. There are probably not more than $1,500,000 at present invested in this line of manufacture in America. There are three factories in Philadelphia, two in Pittsburg, two in Jersey City, two in Taunton, Mass., one each in St. Louis, Mo., Mascoutah, Ill., and Bridgeport, Conn. Some of the largest firms carry on numerous branches of business besides, while others, as, for instance, the Bridgeport company, make nothing but crucibles. Limited as this business is, it has features of special interest. For one thing, it is believed that all the large plumbago crucibles used in this country are homemade, the only imported ones being the small "sand crucibles" used by manufacturing jewelers, chemists, and assayers. This is but partly attributable to protection, although there is a duty of 20 per cent. (not affected by the McKinley law); for even if admitted free the foreign goods could not come into competition with those of home manufacture, since the labor item is so much less than the cost of materials, and the latter can be had as cheap here as in Europe.

The ingredients going to make fireproof pottery are as follows: Plumbago, 50 per cent.; blue clay, 30 per cent.; kaolin, 12 per cent.; fire-sand, 8 per cent. These proportions vary with the quality of the materials used, so that the above formula undergoes continual modification, according to the judgment of the mixer.

True economy requires that none but the very best materials should be employed in making a vessel that has to be subjected to the most intense heat. Hence a few words are here in place as to the sources of supply. Only the richest and purest plumbago is serviceable, as any impurities in it would either melt or burn out, and thus spoil the crucible. Probably a chemical analysis would show that hundreds of tons of the plumbago used is from 99 to 99½ per cent. pure carbon. In other words, the main ingredient of the plain, homely crucible is identical with the finest diamond in substance, differing from it merely in form. None has yet been found in this country that can stand the prescribed test. Hence what is used is imported directly from Ceylon, where it is mined, exceling in purity and fiber any other known deposit. The principal earth combined with the plumbago is the German blue or pipe clay, from Gross Almerode, in Hesse, where it is found in an elevated plateau, being apparently a lacustrine deposit. Its peculiarity is that vessels made from it can be heated without fusing to from 4,000 to 6,000 degrees Fahr., and can also be plunged cold into the furnace or thrown hot from it without cracking—a treatment that French and American clays will not stand.

Clays found in Missouri were thought, at one time, to meet the requirements, but on trial it was found that they would not answer. Both the clay and the plumbago are brought in sailing vessels at a low rate, and free of duty. A curious fact about the clay is that it is cut in blocks, each of which bears the stamp of the municipality owning the deposit. Once a year they have a public meeting and fix the price for the coming year, after which the trade is free to all the world. The kaolin used in crucible making resembles the china clay used in fine pottery, and is found in various parts of our country, there being large deposits of it in New York, New Jersey, Maryland, South Carolina, Indiana, and elsewhere. That found on Staten Island is preferred. The fire-sand used is nearly pure silica, and in any event must be free from iron. Excellent sand for the purpose is to be had at Gayhead, Martha's Vineyard, and on Long Island, near Glen Cove.

The process of manufacture is seemingly quite simple, as explained to me at the Bridgeport Crucible Works, by the courtesy of the manager, Mr. W. T. Macfarlane. The ingredients named are mechanically combined, the mass is kneaded and spun up into shape, properly annealed—and the crucible is done. But short as this process is, it involves its perplexities. Results are governed by obscure and often elusive causes, and any consequent disappointment may involve serious loss.

The continually shifting proportions tax the best trained judgment. For instance, the plumbagoes, while constant chemically, vary exceedingly physically, and the successful manufacturer must vary his combinations accordingly. The clays too must fit the changing character of the plumbago, and the whole crucible must conform to the conditions under which it is to be used. Admirable results may be had in melting one sort of metal in a vessel that would really be worthless for another. A combination containing a tough, fibrous plumbago will give a far different result from that to be had with the same mixture where the plumbago, though chemically identical, is crumbly and brittle. The crucible maker of modern times can readily understand the superstition of the old alchemists that originated the very name of his goods in conformity to which the sign of the crux (the cross) was stamped on the moulded vessel before it was put into the furnace, in order to prevent its being bewitched by the demons of the fire! Following a cast of plumbago from the wharf where it is landed to the grinding room where it is dumped, we see that its contents are made up of bits of mineral of all sizes. These are inspected and assorted. Then they are crushed, and afterward ground to a proper degree of fineness by French buhr stones. The pulverization determines the porosity, on which the ability of the crucible to stand heating and cooling largely depends. If the flour is too fine, the contraction is not taken up in itself as it should be, and the vessel will crack after being used only once or twice. If on the other hand it is too coarse (as occasionally happens), the melted metal leaks out as if run through a sieve. The German clay likewise is crushed and pulverized, after having gone through a preliminary process of drying in dry closets, each holding 20 tons. The different flours and grades are stored in separate bins. The follows the extremely delicate and important task of mixing the ingredients, which is seen to by the manager himself, who is so very careful in this as to weigh down to a quarter of a pound in a ton and a half of material. The mass next goes to a mixing tub, where it is kneaded by rotating blades till it is homogeneous,

after which it is stored in moist blocks in the blank room ready for the wheel.

There is no need of my digressing here to describe the simple mysteries of the potter's art—the most ancient and least modified of all arts. The wheel on which the smaller crucibles are spun is almost the exact counterpart of that known to have been used by the prehistoric Neolithic man. But for larger vessels, intended to hold from 400 to 600 pounds of melted metal, special contrivances have been invented to assist the potter in giving shape to the mass of clay at his disposal. He first kneads it over and cuts it through and through with wires to detect the presence of bits of iron, gravel, or other foreign substances. Having patted the mass into an oblong lump, he next drops it into a prepared mould. This used to be made of plaster of Paris, in which the pot would have to stand for some time before being removed. Of course in a large establishment the number of plaster moulds needed would be great, and would occupy much space for storage. Driscoll's patent wooden mould is now used, lined with loose cloth, so clamped as to be able to be taken away as soon as the pot is shaped, leaving it intact. One mould may thus be kept constantly in service, and far more rapid and satisfactory work is done, because the dough does not need to be so wet as in the old process. After partly drying, the crucibles are pared to a proper finish and placed on shelves in large drying rooms to season for from ten to twenty days. Then they go to the annealing ovens, which are at first very gently heated, but afterward to an intense degree. It occasionally happens that a "green" pot gets by mistake into the oven, and as the moisture is changed into steam, it is rent to fragments with a report like the discharge of a cannon. The sound crucibles, after cooling and due inspection, are suitably packed for shipment. Even after they get into the hands of the brass founders, or others who intend to subject them to a fierce heat, the pots are stacked for supplemental seasoning above muffles in which other work is being done. The best crucibles are expected to stand sixty or seventy rounds for melting purposes. The fragments of those used up in the brass foundries are treated as worthless; but those used in making steel are not injured to such a degree as to prevent their being cleaned from slag and ground over again for use in making a cheaper grade of fire-pots.

In view of the rapidly increasing demand for all conceivable compounds of zinc, copper, silicon, aluminium, etc., it is evident that the manufacture of first class crucibles will become an industry of constantly growing importance. It is essential to the finest results that the materials of which the crucible is made should not attack nor affect in any disastrous way the metals that are to be melted in it. It is also desirable that the metals should not undergo any degree of chemical absorption by the ingredients of the pot. To some extent this is unavoidable; as in the manufacture of steel, which does absorb a certain amount of carbon from the plumbago. For this reason superiority is claimed for the Sheffield steel, because it is not melted in plumbago vessels. But on the other hand it is asserted that makers of crucible steel make due allowance for this unavoidable absorption of carbon. In addition to its other qualities the crucible should be a free melter, readily absorbing and transmitting heat; for otherwise heats are delayed, furnaces rapidly burned out, and too much fuel consumed in proportion to the results gained.

In conclusion, we may sum up the qualities of a perfect crucible in the words of Mr. Macfarlane: "It must combine the highest refractibility with the ability to pass through enormous gradations of heat without warping or cracking; it must be firm enough to stand a high melting heat; it must not injure the metal made in it, nor subject it to loss by leakage through the pores; and it must absorb and transmit heat readily." The only true test is actual use. And as failure in actual use may involve serious and costly consequences, too high an estimate can hardly be put upon the need of skill, experience, and sound judgment in crucible making.

THE AMBER FISHERS OF THE BALTIC.

THE Samland, the region lying between the Frisches Haff and the Kurisches Haff, equidistant nearly from Dantzig and Memel, is the home of the amber fishers of the Baltic. Germans call it the California of East Prussia, and, standing under the shadow of the lighthouse at Brusterort, where the peninsula juts out into the sea, one can see with the naked eye, on a moderately fine day, the entire stretch of coast from which, for more than three thousand years, the bulk of the amber supply of the world has been obtained. Twenty, thirty feet deep, and more, beneath the sand dunes that extend for miles around, and form the ocean floor here, are the veins of "blue earth," as it is termed locally, in which the petrified yellowy and yellow-brown masses are found embedded; and a little way out beyond the lighthouse, on the Fox Point, where a fleet of black boats generally rides at anchor on the gray-green water, is one of the great amber reefs of the "Bernstein-Kuste," a veritable layer of amber cropping up in the sea bed, and heaped up by the ceaseless action of wind and water. The "blue-earth" formation runs far back inland, so that amber can be mined as well as fished, as it, in fact, is in some places in the district. But as the deposit is so much nearer the surface under water, where it is being continually exposed by the gradual sinking of the sea level, while the ebb and flow of the tide and the frequent storms that occur along the coast help to free the amber from the sand and weeds in which it is hidden, it is found more profitable, as well as easier, to "fish" than to "dig" it.

A few years ago, digging was largely carried on in the Samland, and assumed almost the proportions of a regular industry. Five or six peasants, not possessing the right to "fish," would combine, and obtain permission to excavate in likely spots on the estates of private persons. The result was profitable, but, in the end, the "digging" proved a source of unmixed evil to the locality. The "diggers" began to cheat the proprietors of their proportion of the yield, and invariably concealed a good find. Dealers, who crowded into the district, in the hope of picking up bargains, cheated the diggers. Then people commenced digging in parts forbidden to them, making what was termed "moonlight" expeditions to promising grounds. Fights with inspectors were of constant occurrence. When disturbed, the "diggers" had no hesitation in having resort to firearms, and murders became quite common, so that the government was obliged to prohibit this form of amber getting. The right to "fish" belongs to the coast villages and communities, and, in parts, to the state. The latter farms out the grounds belonging to it to certain Königsberg and Memel firms. One of these, Messrs. Stantien & Becker, agreed, in 1862, to keep open the waterway of the Frisches Haff—which needs constant dredging—and pay 25 thalers a day besides, if they were allowed to dredge there for amber. That the contract proved not unprofitable to them may be inferred from the fact that, when the six years for which they had tendered expired, they offered 200 thalers per working day instead of the original 25. The take of amber at Schwarzort, where the dredging is carried on, was estimated at 75,000 pounds for the working year of about thirty weeks.

Amber fishing is no child's play, and the fishers of the Samland are an exceptionally vigorous and hardy lot of men, as they need to be, seeing that they work either shoulder deep in the water, when the salt spray dashing over them falls in chilling icicles upon their faces, or are obliged to spend hours in a constrained position on the sea bottom, in heavy diving armor, when the air temperature is often a good deal below freezing point! They are not Germans, but Samaites, of the Kurish race, who have given a good account of themselves in many a frontier fight with Cossack and Russ.

Stormy weather is the time to see the village fishers at work, for then wind and wave do what man's hands cannot accomplish. The sea, lashed into fury, loosens the bowlders that press upon the amber masses underneath, disentangles them from the weeds and "sea tang," by which they are attached to the bottom, and sets them rolling inshore. Scouts are always on the look-out for approaching bad weather, and when a fierce northeaster comes roaring down the Baltic, sending the surf surging over the sand dunes, and strewing the sand with wreck, the fisher villages are warned that their harvest is a-ripening. Soon all are gathered near the water's edge, ready for work. The fishermen, armed with long hooked forks and hand nets, wade shoulder deep into the sea, careless of the waves that buffet them to and fro and seem almost to take them off their feet at times. With their forks some poke at the masses of seaweed and "tang" driven toward them by the crested surf, and catch as much as they can, and drag it landward, while others try to gather in their nets any stray pieces of amber tossed about by the surging waves.

As fast as the masses of weed or single pieces can be got ashore, they are passed on to women who stand as near as they can to the water, and who quickly loosen them from the fragments of amber, large or small, that may be attached. These are then put into bags, sorted, and sold to the dealers, who not unfrequently accompany the fishermen on such occasions, in the hope of picking up a fine specimen before any rivals have the chance of seeing it. As it happens, though, it is the smaller pieces of amber that are cast ashore by the sea. The larger and finer blocks are rolled about on the sea floor and remain behind, the ceaseless play of wind and wave helping to cover as well as to uncover them. To get at these, the amber seekers wait a day or two until the wind goes down and the storm abates. Then, when the sea is smooth enough to see the bottom, they row out into the shallows, where there is not more than five to fifteen feet of water, and look for any amber blocks the waves may have uncovered or rolled in during the gale. When such are found they are raised by means of long pronged forks, and nets held out as before. On a fine morning, after a stiff hurricane has been blowing in the Baltic, scores of little boats may be seen off the shores of the Samland peninsula, the occupants bending over the sides, and eagerly peering into the sea in search of any amber treasures left by the departed storm. But the village fisherfolk only get the gleanings. The harvest proper is gathered by those at work on the amber reefs in deeper water.

For reef fishing, which is carried on off the coast of Brüster-ort, divers specially trained to the work are employed. The reef, a little to the northeast of the Samland promontory, is the most valuable in existence. It is over six hundred feet long, and more than four hundred feet broad, and consists of solid pieces of amber, deposited by the currents that meet just there, and embedded in the sand and seaweed that accumulate about it, and covered, in some parts, by huge bowlders and blocks of stone. The barrier has been formed in the course of many centuries, and is now worked ten months out of the year, by the little flotilla of black boats that lie about three-quarters of a mile out, off the Brüster-ort lighthouse. Seen at a distance, the occupants of the boats seem idle enough as they sit in the stern, silent and preoccupied; but, rowing out to the fleet, one finds the men to be busy enough. Each of the half-score boats at anchor here has six hands on board, besides the divers, who are at work below. Two pairs take charge alternately at the air pumps, which must be kept going without an instant's stoppage. One holds the life lines in his fingers, watching for the least pull, which is the signal to haul up, and the last is the overseer, who keeps an eye on everything.

The pumpers fix their gaze steadily upon a little dial plate placed amidships, and do not even turn as we row close up to them. They are watching the air pressure gage, for too much air would prove as fatal to their mates below as too little, so their eyes never wander from the register in front of them. Every now and then strange and uncouth-looking figures are drawn out of the depths and rise to the surface, dripping wet, and are hauled into the boats—divers, evidently, and yet unlike ordinary divers—monsters, whose heads appear to hang down in front and wobble as they rise, and with curious humps on their backs. The amber reef fisher has to work in a lying and recumbent posture, so that the ordinary diver's equipment has had to be modified to suit him. Instead of the helmet, with its barred goggle eyes, being screwed on to his shoulders in an upright position, it projects forward, to relieve the neck and collar of the strain and hangs down in front, so that his appearance as he rises from the deep, with the water dripping from his pendent top covering, is ludicrously like some sea animal with a snoutless head that waggles solemnly from side to side. To the back of each is strapped what looks, at a first glance, like a soldier's knapsack, but is really a metal box, with an upper cylinder, constituting an air reserve, so arranged as to supply the diver at each inspiration with exactly the quantum of air he needs, and no more; while the expired carbonic acid gas rises through another passage to the upper atmosphere.

As the divers are hauled into the boats, the overseer takes from a receptacle round the waist any amber blocks that have been attached to it. After a few minutes' rest, the fisher descends, and resumes his work below. With stout crowbar and pronged iron he pokes about among the masses of weed, and sand, and stone that form the sea bottom, until he detects the presence of an amber mass. Or, crawling about on hands and knees, he loosens from the sea floor any blocks recent storms may have partially dislodged. Often these pieces require two, or even three, divers to move them, and gigantic slabs have, now and again, been found that resisted even the united strength of three pairs of hands to disentangle from the masses of stone and weed encumbering them. The fishers remain down five hours a day, and though in autumn the sea is icy cold, so severe is the strain of working under water that they rise to the surface bathed in perspiration.

When gathered, the amber is sorted according to color and size. Pale, straw-tinted pieces go to the pipe makers of Constantinople, North Africa, and the Levant, and are made into mouthpieces; the light, bone-colored and veined slabs are sent to grace the classic busts of the peasant women of central Italy; while the full yellow, sherry-tinted specimens find their way to the South Sea Islands and inner Africa, where, worked up into necklets and beads, they are destined to adorn the ebony necks of the dusky beauties of Otaheite or Timbuctoo. Water amber is nearly all transparent and glasslike. Earth amber—that is to say, amber obtained by digging—is of the smoky kind, more white than yellow, and quite opaque. Only the finer sorts are obtained from the "reef" off Brüster-ort, and these fetch on an average about five thalers, that is fifteen shillings, per pound. Large blocks fetch proportionally higher prices than smaller slabs, while exceptional specimens, of unusual size, run to fancy prices altogether—fifteen, and even thirty, pounds sterling, it is said, having been paid for such samples. Most of the ordinary qualities of amber go to Leghorn and Venice. In return, northeast Prussia takes coral gathered from the reefs of the Adriatic.

This is due to the fact that in the Baltic provinces of Germany and the neighborhood custom ordains that brides and young married women shall appear in a curious ornament of red coral. It is made by stringing coral beads on a stout silken cord, the smallest beads procurable coming first, larger next, then still larger ones, until the largest of all are reached. This ornament is worn in such a way that the smaller beads are round the neck, the next in size round the shoulders, while the largest cover the bust, and depend down the back. The cost of a perfect string of coral like this is over fifty pounds sterling, and all well-to-do Polish families consider it an indispensable item of a bride's outfit. Hence the demand for coral is pretty regular and constant in the North; and in this way it comes that, practically speaking, the produce of the Italian coral reefs is exchanged for the yield of the Baltic amber fishery.—London Standard.

NEW METHOD OF PRODUCING HIGH TEMPERATURES.

THE Times recently gave a very full report of a paper on this subject by Mr. E. D. Lange, of Manchester, read at the Paris meeting of the Iron and Steel Institute. The author had seen the system described, the invention of Dr. Hans Goldschmidt, in operation at the courts of the Chemische Thermo-Industrie Company at Essen, and had concluded that for various metallurgical purposes the engineer and chemist had now at their disposal a new and powerful agent sufficiently cheap and effective and sufficiently under control to justify its existence both from a practical and commercial point of view. The principle underlying the process is not new, being based upon the heat energy developed by the chemical action of aluminium upon oxygen, or rather that between aluminium and certain metallic oxides. It is rather the manner in which this action is developed and its product applied which constitutes the novelty of the process.

The author referred to previous experiments made by Wöhler, Sainte-Claire Deville, Claude Vautin, Bunsen, Tissier, Michel Beketoff, Rose, Percy Greene, Wahl, of Philadelphia, and others. Some very interesting laboratory experiments showing the possibility of producing pure iron by reducing ferrous oxide with aluminium were brought before the Institute in 1895 by Robert Abbott Hadfield, whose services to the metallurgy of iron and steel have been of the most valuable kind, and in the same year Sir William Roberts-Austen gave a brilliant demonstration before the Royal Institution upon the "reduction of the rarer metals from their oxides," on which occasion several of the rarer metals were produced in some quantity, by reduction with aluminium, in a manner which appeared almost magical. Among other valuable investigations since then have been those of Moissan, Kupelwieser, Matignon, Helouis, Duboin, Gauthier and Francke.

Dr. Goldschmidt made experiments with the object of discovering a mode of controlling the violent reaction obtained by the heating of aluminium in contact with metallic oxides, and these brought to light the important fact that it was not necessary to heat the whole mass up to the requisite temperature for ignition, but that it sufficed to start ignition at any one time. When combustion once started, the reaction proceeded steadily with more or less speed throughout the whole mass, thus generating within itself the whole of the heat required. In the case of the refractory oxides, it would have been a difficult matter to apply the requisite heat for ignition at any point, had not Dr. Goldschmidt made the still more important discovery that although certain oxides combined with aluminium at so low a temperature that they could be ignited with an ordinary match, yet they nevertheless, in their combustion, developed so much heat that if a small quantity of these oxides was placed upon a mix-

ture of refractory oxide and aluminium and ignited, a reaction was started in the same, which, thus originated, then proceeded automatically as before. The heat developed by the combustion of a mixture of alumina and iron is sufficient to start the reaction between the aluminium and iron oxide mixture, and as this proceeds, more and more of the same is added until within a minute or two there is a crucible containing reduced iron covered by a thick coating of alumina slag. On pouring off the slag the temperature of the underlying liquid iron can be tried by pouring it on to a mild steel plate or along the side of a mild steel bar, when the hot iron cuts its way through with ease. Pyrometer experiments have established the temperature reached in the operation at between 2,900° C. and 3,000° C.; that is to say, 1,000° C. more than that reached during the hottest period of the Bessemer blow. In the case of the reduction of chrome from its oxide by this method, the temperature of 3,000° C. is certainly reached—a temperature hitherto obtainable by the electric arc alone. Aluminium is, therefore, a very powerful source of heat, wonderfully condensed and portable and adaptable to many industrial operations. Aluminium and oxygen are two of the most common of the elements of which the earth's crust is composed, and it can hardly be doubted that the price of aluminium, already low, will be still further reduced in the future. The production of carbonless chrome and manganese on this system was next described.

It was explained that welding by means of aluminium mixture is conducted by pressing together the two ends of the bars or pieces to be welded, and then placing round the part to be welded, but separated from it by a fixed distance, a form made of thin iron sheeting supported by being packed round with moulding sand. The combustion of aluminium and iron oxide is then effected in a crucible of fitting size, and the contents of the crucible poured into the form. As soon as the part to be welded has taken up sufficient heat, the weld is accomplished by pressing the two parts together by means of a suitable clamping arrangement. Raw aluminium of 50 per cent. purity made from bauxite has a sufficient effect. It is of no consequence how far the reduced iron ore is pure or impure. On the other hand, if it is proposed to use the reduced iron to form part of an iron or steel structure, its purity of composition might prove an important matter. With regard to the comparative cost of the joint as compared with a fishplate joint, Dr. Goldschmidt has prepared some figures in which consideration is given to the cost of the maintenance of the fishplate joint, and he makes out a favorable case for the welded joint. The reports on this subject have been hitherto of a favorable character.

It appears more than likely that this process will be largely used in the future in order to secure continuity of conductivity in the return current on electric railways. With regard to the comparative cost of welding by thermit and electricity and of welding by electricity, it is hard to find common ground for a comparison, as the number of cases in which electricity is sufficiently available and its use expedient is necessarily limited.

The author concluded by pointing out the unsuspected property of aluminium as a heat accumulator, whereby it is rendered possible to release in the form of heat, everywhere and with the greatest ease, the work which was required for the original production of the aluminium. Another thought is not far removed from this—namely, the possibility of using aluminium not only for the processes described, but to discover a means of turning the heat of combustion of the aluminium back into electricity for the production of power. It is, indeed, possible that in the future the value of aluminium will lie not only in its properties as a metal, but also in its importance as a power accumulator of the highest efficiency.

Two years ago, H. Starke described a study of the diffused reflection of cathode rays, and showed that the reflected rays take their charges with them. He has since repeated the experiments with greater precautions, and has studied more especially the reflective powers of copper and aluminium for cathode rays. Mirrors made of the two metals were placed inside a metallic cylinder through an opening in which the cathode rays entered. A galvanometer connected with the mirror measured the amount of cathode radiation absorbed. The amount reflected and diffused was measured by nearly surrounding the mirror with a second cylinder fitting in the first, and connected with another electrometer. The two metallic cylinders were inclosed in a vacuum together with the cathode furnishing the rays. The mirror was put into two different positions in the cylinder, so as to determine the amount of cathode radiation diffused by the gas itself. The reflective power of aluminium was found to be 28·2, and that of copper 45·5, whatever the velocity of the cathode rays. This ratio is, by the way, very nearly the same as that of the square roots of the atomic weights of the two metals. It would be well to find out whether such a rule would hold good throughout. —H. Starke, Ann. der Physik, No. 9, 1900.

In view of recent attempts to bring thermal and electrical conduction under the common theory of electrons, the ratio between the two conductivities in question acquires additional interest. E. Grüneisen has therefore examined the influence upon this ratio exerted by certain impurities in copper and iron. He determined the thermal conductivities of four iron bars and three copper bars by projecting a current of steam against their end surfaces, as in Schulze's method, and following the propagation of the heat through the bar by means of a thermo couple, one element of which was the bar itself. In copper, it was found that a very small proportion of arsenic suffices to reduce the thermal conductivity to one-tenth of its value in pure copper. The electrical conductivity is depressed at the same time to one-twelfth of its original value. In iron, the difference is even greater, the electrical conductivity being a great deal more sensitive than the thermal conductivity. Thus the ratio of the former to the latter, which is 1,790 in nearly pure iron, becomes 2,160 (C.G.S.) in an iron bar containing 1·5 per cent. of carbon, 0·19 of manganese, and 0·05 of silicon. The electrons conveying electric charges are evidently more disturbed by foreign bodies than those which convey heat only.—E. Grüneisen, Ann. der Physik, No. 9, 1900.

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